THE AMERICAN GAS LIGHT JOURNAL

REDMANKENNY.N.Y.

PUBLISHING OFFICE No. 32 PINE STREET

DEVOTED TO THE INTERESTS OF ILLUMINATION, VENTILATION, WATER SUPPLY AND DISTRIBUTION, & GENERAL SCIENCE

VOLUME LXIV.—No. 16 Whole No. 1,089. | NEW YORK, MONDAY, APRIL 20, 1896 | $3 PER ANNUM, IN ADVANCE.

A. M. CALLENDER & CO., Proprietors. C. E. SANDERSON, Manager.
JOS R. THOMAS, C.E., Editor. T. J. CUNNINGHAM, Asst. Editor.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y., AS SECOND-CLASS MATTER.

Published on each Monday of the year, at No. 32 Pine Street, New York.

Terms of Subscription, Including Postage—For the United States and Canada, $3 per annum. European countries, $4.50 (19 shillings—22½ francs). All payments to be made in advance. Single copies, 10 cents.

Remittances should be made either by post office order, express money order, registered letter, or bank draft on New York, payable to the order of A. M. Callender & Co.

Collections are invariably made directly from this office for subscriptions, advertisements, etc. We have agents to solicit the same, but they are not authorized to receipt for money.

The American News Company, Nos. 39 and 41 Chambers street, New York, are agents for this JOURNAL. Newsdealers will send orders to them.

Correspondence.—Wishing to make this JOURNAL a gazette of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, correspondence is solicited for publication from all who make the study of those subjects a pleasure or a profession.

The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

CONTENTS.

An Asterisk (*) denotes an illustrated article.

OFFICIAL NOTICES—
Second Annual Meeting of the Texas Gas and Electric Light Association..... 605
Nineteenth Annual Meeting, Western Gas Association..... 605
EDITORIALS—
Briefly Told..... 606
The Western's Nineteenth Meeting—Death of Mr. Frank Shippen—Notes.
The Relative Value of Different Coals, by Mr. H. M. Chance..... 606
Gas Pipes and Steam Rollers, by Mr. N. H. Humphrys..... 608
*The Practical Use in the Chemical Laboratory of the Electric Arc Obtained from the Low Potential Alternating Current, by Mr. Milo S. Walker..... 610
Supporting Power of Piles, by Mr. Franz Kreuter, C.E..... 611
*The Waters Gas Manufacturing Apparatus..... 612
Cost of Pipe Laying..... 614
Judge Clark's Decision on the Plea of the New Memphis (Tenn.) Gas and Light Company for an Injunction to Restrain the Authorities from Enforcing an Arbitrary Gas Rate..... 615
ITEMS OF INTEREST FROM VARIOUS LOCALITIES..... 613
Resignation of Mr. D. Davis, Iowa City, Iowa—The City Council of Norristown, Pa., Moves in the Matter of a Municipal Gas Supply—Officers Chosen, Consumers Company, Newburgh, N. Y.—A Hint from "Observer"—Cheaper Gas for Westfield, Mass.—The Jamaica Plain (Mass.) Company Accepts the Recommendation of the State Commission—Proposed Gas Legislation for Massachusetts—Mr. Vinton W. Mason Takes Unto Himself a Bride—Death of Mr. John Edwards—Something from Kenosha, Wis.—Contract for the Berlin Iron Bridge Company—Death of Mr. William Newell—Annual Report, City Gas Works, Richmond, Va.—Suing the Greenfield (Mass.) Company—And Other Items.
Encouraging Petroleum Refining in Germany..... 618
The Coal Fields of China..... 618
The Market for Gas Securities..... 619

[OFFICIAL NOTICE.]

Second Annual Meeting of the Texas Gas and Electric Light Association.

OFFICE OF SECRETARY, GONZALES, TEX., March 28, 1896.

The following is a partial list of papers prepared for our second annual meeting, which will be held at Dallas, Tuesday and Wednesday, May 12 and 13, 1896:

"Electric Light Companies and their Consumers," by Mr. L. T. Fuller, of Calvert.

"Fixed and Variable Expenses in Manufacturing Plants," by Mr. Thos. D. Miller, of Dallas.

"Our Association," by Mr. A. E. Judge, of Tyler.

It is understood that Mr. Bauer, of Texarkana, Mr. Cullinane, of Denison, and Mr. Lord, of Fort Worth, will have short papers.

Such papers as are forwarded to the Secretary 20 days before the meeting will be printed (in sheet form) and a copy mailed to each member.

The "Question Box" is open to all, and will be quite a feature.

The question of a "Wrinkle Department" (among other matters) will come up, and it is expected that all who have originated, adapted or adopted some useful method or device will come prepared to tell about it.

The meeting will be called to order promptly at 10 A.M., Tuesday, May 12.

The names of the following gentlemen as Committee of Arrangements, Thos. D. Miller, H. L. Monroe, J. C. Lord, are guarantees that nothing will be left undone for the comfort and convenience of members and visitors. This Committee will make all necessary arrangements as to details of programme for both days, secure headquarters, look after hotel rates, etc.

HOMER W. STARR, Sec'y.

[OFFICIAL NOTICE.]

Nineteenth Annual Meeting, Western Gas Association.

WESTERRN GAS ASSOCIATION, OFFICE OF THE SECRETARY,
NEW ALBANY, IND., April 14, 1896.

The nineteenth annual meeting of the Western Gas Association will be held at Lookout Mountain, near Chattanooga, Tenn., May 20, 21 and 22.

The meeting will be called to order by the President, Mr. A. W. Littleton, at 10 A.M., Wednesday, May 20.

"Lookout Inn" will be the Association headquarters, and its business sessions will be conducted therein.

The Southern States' Passenger Association, Central Traffic Association, Trunk Line, Chicago and Ohio River Traffic Association, and the Chicago and Alton Railroad, from all points in Illinois, have granted rates on the certificate plan of 1½ fare for the round trip.

The Question Box is now ready to receive inquiries. All members desiring to avail themselves of the privilege will mail their questions to the Secretary as soon as convenient.

The President has appointed the following Committee of Arrangements: Messrs. Jas. Forbes, I. S. Post, Henry Clay Evans and T. H. Payne, of Chattanooga, Tenn.; Robt. Young, of Knoxville, Tenn.; E. H. Jenkins, of Covington, Ky.; and Jas. T. Lynn, of Detroit, Mich.

JAMES W. DUNBAR, Sec'y.

BRIEFLY TOLD.

THE WESTERN'S NINETEENTH MEETING.—In this number appears the preliminary announcement from Secretary Dunbar respecting the nineteenth annual meeting of the Western Gas Association, which is to be held on the historic heights of Lookout Mountain, a ridge that abounds in grand and picturesque scenery, and which is never more charming than in mid-May. As Secretary Dunbar points out, the sessions of the Association are to be held in Lookout Inn, an abiding place that is fully up to the complete and comfortable housing of the members and their guests, no matter how many of each respond in person to the official call. Although the Secretary was unable at the time of writing to give a detailed list of the papers that are to be read, it is nevertheless known that at least five communications are in course of preparation, two of which (by Mr. B. E. Chollar and an "Unknown") promise to be exceptionally interesting. This insures enough matter of the solid sort for a successful meeting, and it is hoped that the Question Box will be filled to the cover with queries that will lead to profitable and interesting debate. To the set papers and the contents of the Question Box must be added the features of the "Wrinkle Department," under the business-like editorship of Mr. Geo. T. Thompson, who has been working with the tact, method and directness which are concomitants of his usual practice in any field. President Littleton, who has been over the scene of the meeting ground, has named an excellent Committee of Arrangements, and, in conjunction with the Secretary, has also succeeded in securing the consent of the transportation companies to grant a round-trip rate equal to a fare and one-third—a concession that will result in a sensible saving to those who shall make the journey. While it has not yet been settled officially, it is on the cards that the railroads will agree to change the point of destination, from Chattanooga to Lookout Mountain, which will save the rechecking of baggage from the former to the latter place. The members should see to it that the meeting will be largely attended, since the sessions this year are under the Presidency of Mr. Littleton; for in such manner will he feel best repaid for the yeoman's work which he for years has devoted to forwarding the Association's advancement.

DEATH OF MR. FRANK SHIPPEN.—We regret to report the death of Mr. Frank Shippen, General Superintendent of the Hudson County Gas Light Company, of Hoboken, N. J., who was stricken with pneumonia on April 2d, and succumbed to the disease on April 6th. Mr. Shippen was in his 44th year, and since his 19th year had been connected with the Hudson County Company. He entered its service as Assistant Superintendent and finally became Superintendent, the duties of which position were carried on by him with credit to himself and with profit to the Company. He was a brother of the late Mr. W. W. Shippen, who in his day was well and favorably known to the business men of this vicinity through his conservative and successful handling of the Stevens estate.

NOTES.—Mr. Daniel T. Roots, President of the P. H. & F. M. Roots Company, writing under date of the 10th inst., says that the Company has still on hand some of the glass paper weights of the type sent out by it not long ago. Those who would like to secure one of the weights can obtain it by sending on their addresses through the medium of a postal card. The Company is completing a large addition to its machinery department, which, taken in conjunction with the recently completed foundry, will just double its capacity. The President further says that the indications are for an exceptionally good business year in the Company's various specialties.——Mr. Charles H. Sprague, of Boston, Mass., has issued the following invitation, which explains itself: "Mr. Charles H. Sprague, remembering 'Auld lang syne' and his 'three score years and ten,' invites the Guild of Gas Managers and their friends to meet him at Young's Hotel, Saturday, April 25, 1896, at 1 o'clock." It is needless to add that the well-beloved veteran will be the central figure of a goodly company.——At the annual meeting of the Tonawanda (N.Y.) Gas Light Company no change was made in the executive management. The annual reports of Mr. H. M. Stocum, General Manager, showed a satisfactory increase in the Company's business, and special mention was made of the success which attended the placing of Welsbach burners for indoor and outdoor lighting. The Directors declared a dividend of 3 per cent., payable on demand.——The corporate title of the Springfield (O.) Gas Light and Coke Company has been amended to that of the Springfield Gas Company. ——Work on the new office building for the Newark (N. J.) Gas Company will be commenced May 1. The structure will be five stories high, the first of which will be in Belleville brown stone, the next three to be of mottled brick, and the fifth will be topped out in "old Dutch" style. The first and second floors will be occupied by the Company, and the other floors will be fitted up as high-class apartments. The site, as formerly reported by the JOURNAL, is at the corner of Broad street and Central avenue. It is thought the structure will be finished by December 1. Mr. H. J. Hardenbergh, of New York, is the architect.

The Relative Value of Different Coals.

By MR. H. M. CHANCE, in *Engineering Magazine*.

When used to produce heat, the value of coal depends upon the quantity of heat obtained from it. This is the chief function it performs, and the one this article proposes to discuss. Its use as a metallurgical agent for reducing or smelting metals from their ores, and for the working and manipulation of metals, constitutes a distinct field subject to conditions which cannot be here defined.

From 1 pound of good coal enough heat can be obtained to evaporate a little more than a gallon, say 5 quarts or 10 pounds, of water. If, with such a coal, another be compared which will evaporate but 2½ quarts, or 5 pounds, of water, the thermal value of the second coal is said to be one-half that of the first.

The relative thermal values of coals are, therefore, their relative capacities for producing heat, and it is evident that commercial values should be proportional to these thermal values.

In determining thermal values, the scientist or physicist deals, or attempts to deal, with the whole amount of heat produced by the complete combustion of a given quantity of fuel, including the heat escaping with the waste gases through the chimney, that lost by radiation and even that carried away in removing the hot ashes.[1]

As in practice much of this heat is necessarily lost through radiation and imperfect combustion, some carbon going off as smoke or soot and some combustible gases escaping unconsumed, we cannot adopt the scientist's standard for practical work. Hence we take as a measure of value the actual heat utilized, as shown by the quantity of water evaporated by each pound of coal under the conditions present at any particular steaming plant, the thermal values so determined indicating the real value to the consumer of the coals under consideration.

When fuel cost forms a large item in the total cost of production, the value of coals is often the subject of careful experimentation. Practical trial runs are made with different coals to determine under existing conditions which coal gives the best results at the lowest relative cost. The results of such tests often develop the fact that personal judgment in such matters, unless based upon actual figures, is of little value. I have in mind a simple little case of this kind, where the choice of fuels was between two pea (anthracite) coals, one of which was better, but also higher priced, than the other. The judgment of the fireman and engineer was that it did not pay to buy the cheaper fuel, that the plant took "one-third more coal" when using it, etc.; the actual figures for equal work were:

100 tons pea coal, at $3.50.....	$350
108 " " " 3.00.....	324

When careful records are kept of the coal consumed and the water evaporated or work turned out, the relative values of any coals can be reliably determined by trial, but such tests are expensive and troublesome, involving the cleaning up of all coal remaining on hand, with perhaps more or less trouble in making steam with the new fuel until the firemen learn its peculiarities. Hence the consumer is generally averse to experimentation or change, and, unless fully convinced that the new article is much better or much cheaper than the old, cannot be persuaded to try it.

A change in fuel is especially obnoxious to most firemen. Protests from both firemen and engineers may be expected whenever the fuel is changed, whether the change be from a poor to a good fuel, or *vice versa*. They arise from the fact that the thermal value of a fuel at any plant—*i. e.*, the water converted into steam—depends largely upon the conditions present at that plant, and also upon the method of firing and the knowledge, versatility and integrity of the firemen using it.

An instance illustrating this feature occurred in the experience of the writer, who was consulted regarding the fuel supply for a steaming plant consisting of about a dozen isolated boiler plants consuming in the aggregate about 100 tons of coal per day. The fuel in use was a good coal, but, as it contained much gas, was "sooty" and fouled the boiler tubes, notwithstanding frequent scraping and blowing out. Consequently the fires were being forced nearly all the time, and the economy of the plants as steam producers was correspondingly low. As a result of the conference, the writer was authorized to contract for a supply of fuel better adapted to the requirements of the plants, and at once secured a quantity of one of the best bituminous coals coming into the Atlantic seaboard market—a fuel famous upon the transatlantic

1. The thermal unit used in this country and Great Britain is the quantity of heat necessary to raise 1 pound of water 1° F. The French thermal unit, in general use by scientists of all countries, is the quantity of heat necessary to raise 1 gram of water 1° C. The thermal unit commonly used in comparing the value of coals is the number of gallons of water evaporated by 1 pound of coal.

liners. This fuel contained less gas and deposited little soot in the tubes. Nevertheless, upon the arrival of that coal, trouble arose at every plant; protests came in from almost every engineer and fireman. They stated that they simply could not make steam; that the coal was miserable stuff, "contained no gas," "made no flame," etc. At one plant, where a delayed shipment of the former coal was received after the delivery of the new coal had commenced at the other plants, the firemen sent in the same protest—they "could not possibly make steam with the new (?) fuel!" In about a week the complaints practically ceased, and more steam was made at all the plants with less fuel than before the change.

The writer also recalls a similar experience with the firemen of a railway where a change in fuel was met by protests from all parts of the system, which, however, quickly subsided when the men had learned how to handle the new fuel and realized that it was better than that formerly used.

As the thermal value of a fuel, as determined under the ideal conditions required for scientific test, is never realized or even approximated in practice, the consumer is interested only in the relative thermal values as developed under average conditions at his own plant. And the conditions at different steaming plants vary so widely that the best and cheapest fuel for one plant may be a very unsatisfactory and costly fuel at another. Some of the best coals produce light, fine, even pulverulent ash, which, as burned under some boilers with horizontal tubes, quickly clogs up the tubes and greatly reduces the economy and capacity of the plant; under such conditions an inferior coal may produce better results, while, in a plant with vertical tubes or in a highly inclined water tube boiler, the results would be very different. The same conditions affect the thermal values of coals with large percentages of gas, and of coals yielding a very rich or smoky gas. Here it becomes a question of grate area, thickness of fire, size and arrangement of combustion chamber, and admission of air above the grate. If these conditions are not adapted to the coal, no possible amount of scraping and blowing out of the tubes will keep them clean enough to give satisfactory results with such a fuel, and better results may be attained with a much poorer coal of different character.

It may, however, be asserted at the outset that conditions causing in practice such abnormal relative thermal values should be regarded with suspicion, and it is safe to predict that, where such conditions obtain, it is entirely possible, in a majority of cases, to so correct the management, construction or arrangement of the plant as to make it produce results consistent with the real values of the fuels used. At the same time we should remember that what may prove a faulty and wasteful design for burning one kind of coal may be capable of developing the highest efficiency from another variety.

The problem usually presented is to determine not what grate and boiler setting will develop the best results from the best fuel at the lowest relative cost, but, given a particular boiler with fixed grate and boiler setting, which of several available coals will give the best results at the lowest relative cost. The coal answering these conditions is the best fuel for that particular plant.

As it is manifestly impossible for each consumer to experiment with all of the numerous grades and varieties of coal in the market, a quick and ready method is needed for determining what grades will justify trial. If he is an expert judge of coal, much can be learned from an inspection of the coal, and many grades may be rejected at sight because of the visibly large quantity of slate or sulphur present. If he is not an expert judge of coal, the consumer may profitably be guided by the established reputation, or lack of reputation, of any coal. But the composition of the coal, as shown by chemical analyses, is the best criterion, care being taken always that the analyses represent properly selected average samples.

In analyzing coal, the chemist first drives off the water by evaporation, by heating the coal to 212° or 225° F., the loss of weight giving the percentage of water. The coal is then heated to a red heat in a covered crucible, thus driving off the gas, which is the volatile combustible hydrocarbon, usually called by the chemist "volatile matter," the loss of weight giving the percentage of this constituent. The sample is next heated to a bright red heat in an uncovered crucible, the admission of air to which permits the carbon (coke) to burn, leaving only the ash behind, the loss of weight showing the percentage of carbon—called "fixed carbon" by the chemist—and the residue the percentage of ash. A separate analysis it necessary to determine the percentage of sulphur, which is deducted from the percentages of volatile matter and fixed carbon, already determined, as a part of the sulphur escapes with the volatile matter and the remainder burns off with the carbon.

The valuable constituents of coal are its carbon and hydrocarbon (volatile matter) contents; the waste matter consists of water, ash and sulphur.

Other things being equal, coals with high percentages of volatile matter have greater ultimate thermal values than coals with small percentages of volatile matter. The relative thermal values of the carbon of coal and of the volatile matter are about as 8 is to 14. Assuming for comparison two coals, one with 75 per cent. of carbon and 20 per cent. of volatile matter, and the other with 55 per cent. of carbon and 40 per cent. of volatile matter, the theoretical thermal values are in the ratio of about 8.80 to 10; but such differences are not obtainable in ordinary tests, much less in actual work, owing to the large loss of heat due to unconsumed gases, to imperfect combustion (always experienced in using coals with a high percentage of volatile matter), and to the difficulty of effecting anything like complete combustion of the gases, some of the hydrocarbons being burned only to carbonic oxide (CO) instead of to carbonic acid (CO_2), with a development of less than one-half the heat which would be produced by complete combustion.

Hence, while the law remains that the thermal value of a coal rises with the percentage of hydrocarbons (volatile matter), it will not do to apply this law to present practice. In fact, the bituminous coals, from which some of the best steaming results are obtained, are those coming into the Atlantic seaport markets, which carry a comparatively low percentage of volatile matter—say, from 18 to 30 per cent.

The more perfect combustion and cleaner boiler tubes which can be maintained when burning anthracite enable the consumer to realize a high thermal value from it, notwithstanding the small percentage of volatile matter which anthracite coals contain.

By adding together the percentages of volatile matter and fixed carbon, we obtain the percentage of combustible matter contained by any coal. Coals with high percentages of combustible matter generally have higher fuel values than coals with low percentages of combustibles. Prices should not vary widely from the relative quantities of combustible matter.

A coal with 90 per cent. of combustibles means a coal with 1,800 pounds of combustible matter and 200 pounds of waste matter in each ton; a coal with 80 per cent. of combustibles has 1,600 pounds of fuel and 400 pounds of waste matter in each ton.

Few coals contain more than 90 or 92 per cent. of combustible matter. The combustible matter in high grade coals may be taken as ranging from 88 up to 95 per cent.

The accompanying table shows the typical composition of high and low grade anthracite, semi-bituminous and bituminous coals.

High-Grade Coals.

	Anthracite.	Semi-bituminous.	Bituminous.
Water	1.00	1.00	1.00
Volatile matter	5 00	18.00	40.00
Fixed carbon	88.50	75.50	53.50
Sulphur	.50	.50	.50
Ash	5.00	5.00	5.00
	100.00	100.00	100.00

Low-Grade Coals.

	Anthracite.	Semi-bituminous.	Bituminous.
Water	2.00	3.00	4.00
Volatile matter	5.00	15.00	34.00
Fixed carbon	75.00	67.00	46.50
Sulphur	2.00	3.00	3.50
Ash	16.00	12.00	12.00
	100.00	100.00	100.00

When the relative values determined by actual use vary widely from the values indicated by the percentages of combustible matter, it is advisable to examine closely into the arrangement, condition, and management of the plant; for it is evident that the plant is wasting more heat with some coals than with others, and the cause of this may be remediable, and its recognition and rectification will probably lead to higher efficiency with all coals.

While the consumer may, therefore, rely upon the results of analyses in determining whether, at the price asked for it, any coal will justify its experimental use for the purpose of testing its true value to him, depending principally upon the percentages of total combustibles as shown by the analyses, the character of the impurities is also a factor of much importance.

Each one per cent. of water shown by the analysis means twenty pounds of water to the ton, and a coal showing five per cent. of water will, therefore, contain one hundred pounds of water to the ton. Before the coal can burn, this water must be evaporated by the heat of

the fire, thus causing a waste of heat that would otherwise be available. To evaporate one hundred pounds of water will require the heat generated by the combustion of ten or fifteen pounds of coal. Hence the presence of one hundred pounds of water is equivalent to a reduction in the combustibles in each ton of one hundred and ten or one hundred and fifteen pounds.

The low thermal value of many western coals, and especially of the western lignites and lignitic coals, is principally due to large percentages of water—the range being from about five per cent. up to twenty-four per cent. of water.

Large ash percentages are objectionable, not only because they reduce the quantity of combustibles per ton, but because of the increased cost of labor in firing and in removing and disposing of the ashes, and also because of losses occasioned by the frequent cleaning of fires necessitated by high ash coals.

The character of the ash is also of considerable importance. If easily fusible, it quickly closes the interstices of the grate, burning the grate bars and necessitating frequent cleaning of the fires, with inevitable waste of fuel and chilling of the boilers. If the ash contains large pieces of slate, frequent cleaning, with much loss of coal, can be predicted. Coal yielding a fine pulverulent ash is unsatisfactory under conditions already described.

Because of the damage sometimes done to grates, boilers, settings, and stacks by coal containing a large percentage of sulphur, this impurity is very generally regarded as the most objectionable constituent of coal.

Few coals contain less than one per cent. of sulphur; in many the sulphur rises to two or three per cent.; while some coals much used in the west contain as high as four per cent., or more, of sulphur.

When injury from sulphur is detected, inquiry is generally instituted at once to determine how much sulphur the coal in use contains. If it be found that the coal contains only a small sulphur percentage, the damage is regarded as unavoidable, perhaps no complaint is made, and the fact and cause of damage never gain publicity. Should, however, the coal used be found high in sulphur, the damage is at once attributed to this cause; the miner or agent is censured for shipping inferior fuel, perhaps not up to contract stipulation; that concern loses a customer; and the circumstances and supposed cause of the difficulty become more or less generally known to all those directly and indirectly interested. In this way the sale of many coals has been ruined, perhaps justly, possibly unjustly.

As with many other objectionable things, the injurious effects of sulphur are dependent not so much upon its quantity as upon the form in which it exists in coal, and the manner in which the coal is used, and possibly upon the nature of the structural materials with which it is brought into contact.

Coal containing large quantities of sulphur in the form of iron pyrites is unquestionably hard on grate bars. On the other hand, high sulphur coals are used in some districts with merely nominal damage from this cause. The subject is one not thoroughly understood, and must have careful investigation before it will be safe to make any very positive assertions regarding the action of sulphur in coal.

Meanwhile, in the light of present and past experience, it will be safe to give those coals the preference that show only moderate percentages of this impurity, for it is without doubt the most objectionable element contained in coal.

Gas Pipes and Steam Rollers.

By Mr. Norton H. Humphrys, in the London *Journal*.

The steam road roller appears to be generally adopted, not only on the principal thoroughfares of our populous towns, but also for side streets, and in suburban and even country districts. The result attendant upon its use may be regarded as satisfactory by surveyors and those responsible for the condition of the roads. But the owners of the gas pipes laid under the soil can scarcely look upon its adoption with equal complaisance. It has been remarked that the steam roller finds out the weak places, which is certainly correct. A gentleman is referred to in Longfellow's poem, "The Luck of Eden Hall," who experimented on a valuable piece of old pottery in a similar way; but his procedure does not recommend itself as in accordance with the ordinary dictates of common sense. Some of the so-called weak places that are discovered by the aid of this novel method of investigation, have never proved a source of leakage during a 20 or 30 years' existence; others certainly never existed before. So, while the steam road roller may be a useful machine from the road maker's point of view, I do not regard it as of any use whatever in connection with the testing of gas mains and services for soundness. There is no case on record of its having proved of any benefit in reducing the leakage account. On good roads, accustomed to carrying a large and heavy ordinary traffic, including four-horse vans and traction engines, and that have been well maintained and kept in good order, the steam roller does not put itself much in evidence. But when one of these implements is for the first time put upon a by-street or a country road accustomed to small and light traffic, which has received but little attention in the way of maintenance beyond an occasional scrape in unusually wet weather, and a sprinkling of stones from a cart at rare intervals, the gas engineer becomes more intimately acquainted with "The Luck of Eden Hall" properties possessed by the steam roller than is good for his own comfort or for the prosperity of his undertaking. Difficulties from drawn services and fractured mains—ranging from the slight crack a few inches long up to the complete severance of the pipe—become common occurrences; amenities arise between the Corporation officials who have just made up a good smooth road and the gas works men who go and make it rough again; and much misapprehension exists as to the actual cause, though it need scarcely be added that the gas company are saddled with the blame. Following on the lines of the usual rule that if the gas gives a bad light the company are at fault, it is argued that if the gas pipes break they must be bad pipes; and many members of corporations, etc., arrive at the conclusion that there must be special negligence in putting down, or in selecting the sections or quality of the pipes to be used for the conveyance of gas. So far from getting any sympathy in their misfortune, which has arisen from causes that could not possibly have been foreseen, the unfortunate gas company are blamed for not laying their pipes at a reasonably sufficient depth, or for purchasing cheap stuff of a rotten or ginger bread character. A common argument in support of this view is the fact that gas pipes are injured more frequently than water pipes.

Now it is not the practice with gas companies to buy cheap pipes without regard to quality, or to stint the cost of excavation when laying, though it is quite true that water pipes are, under ordinary circumstances, both thicker in section and laid at a greater depth. This is not because water engineers are more prudent, or have exercised more care or foresight as to possible contingencies, or generally do their work in a stronger or more substantial manner than gas engineers. It is simply a natural consequence due to the different nature of the service performed. The internal pressure to which the gas pipes are exposed is a mere trifle—a matter of a few ounces per square inch. But water pipes are subjected to heavy pressure in low levels, representing a large number of pounds per square inch. Gas pipes in themselves are not interfered with by frost, except as regards its effect on the soil surrounding them; but the formation of ice in water pipes must be prevented, as it not only stops the supply but also fractures the pipe. It would be as reasonable to adduce the fact that that the main sewers are never injured by the roller as to compare water pipes with gas pipes. The main sewer must, for obvious reasons, be laid at a depth of 6 to 8 feet, which is sufficient to put it out of reach of surface troubles under all ordinary circumstances.

The ordinary main road traffic, either in town or country, includes heavy vans, traction engines, and other vehicles carrying quite as heavy base loads as the steam roller; and this implement itself travels the roads to a considerable extent in going backward and forward to its work. Yet one very rarely hears of injury to gas mains or services as the result of ordinary traffic. The drawn service or fractured main is never heard of except where the steam roller has been at work, and worked (as will presently be shown) in a particular way. In my own experience I only know one instance of a gas main being broken by a traction engine; and the circumstances under which this unusual occurrence took place are interesting in connection with our subject. A hydrant situated at the edge of the footwalk was constantly and regularly used for filling watering carts—a process attended with some slopping and spillage, which had been sufficient to penetrate the ground and render it quite soft over a good sized patch. A traction engine pulled up to take a supply of water—the trifling objection that this was contrary to regulations being adjusted in the usual way—and one of the wheels sank a few inches in the soft place, with the result that a 3-inch gas main that happened to be just exactly underneath was broken. It was completely severed, and the broken parts were displaced almost clear of each other. Being a connecting main supplied at both ends, a very serious escape of gas followed—sufficient to completely frustrate attempts to bare the pipe at the spot; and it was necessary to go back some yards each way and cut off the main on either side. This having been done, examination showed that the soakage

had completely demoralized the soil, not only down to, but for some inches below, the gas pipe. The road was on "made" ground—being, in fact, the site of an old brickfield; and the soil was simply rough garden mould, so that the effect of the soakage was to cut away the support below the pipe as effectually as if it had actually been dug out. The result of the settling at the surface was to lower the level of the wheel that did the mischief—thus canting a considerable part of the weight of the whole machine directly on to the line of gas piping, which was thus called to act as a principal bridge girder; and, as might naturally be expected, it proved to be not strong enough for that purpose.

When the steam roller was first introduced into the districts with which the writer is directly concerned, the main and service layers made a complaint about its being applied to freshly disturbed trenches. Directly they had finished a new service, the roller was sent to obliterate, if possible, the evidences of their work; and they considered that the pipes, being unprotected by consolidated ground, would scarcely escape injury. But they soon observed that no harm followed, provided the roller did not actually sink in the newly fillled-up trench. In fact, the practice was of benefit to the gas company rather than otherwise; for the men took more particular care in the way of seeing that the main was well packed underneath, and looked out good solid stuff to fill in round the junction of the services. Neglect of proper attention to this point is responsible for an important factor in the leakage account. There is no instance on record of injury to new work by this practice. A useful insight into the mysteries of the roller action (which not only explains this but also other matters) may be gained by watching the implement at work on a mound over a recent excavation situated on the crown of the road, or left somewhat high as compared with the neighboring surface. The reduction of the excrescence is somewhat slow; so much so that sometimes a hardy laborer provided with a can of water and a rammer could give the machine several points. It will be observed that as long as the roller is level the weight is equally distributed; but directly it is tilted or canted on one side this condition is disturbed. The greater part of the weight is transferred to the lower side, and this is why the high mound escapes. If the soft place happens to be lower (instead of higher) than the normal level, the action of the roller is much more rapid. In the case of the new excavation this is a great advantage; but when the gas pipe happens to be laid under the lowest part of the road level it is a great disadvantage. One may safely say a large percentage of the total breakages are due to the canting or tilting of the roller, which throws the largest part of the weight just in the weakest place; and they would not occur if the roller never deviated from the horizontal.

Road surveyors appear to have generally adopted, by common consent, something like a bow or segment shaped cross section, as best suited for roads. As compared with the segment of a circle, it is rather flat at the crown, and exaggerated toward the sides at the gutters. This is quite a new idea as regards many of our roads. The cross section has been left to chance, and there has been no endeavor to preserve any special shape, so it has settled down into an irregular approximation to the horizontal. The center of the road tends to wear down more rapidly than the sides, and the custom was to compensate for this with an occasional thin dressing of stone. This was not done with any regularity, but there was a regard for economy of material and labor which occasionally traversed so far as to reach actual neglect, and arouse complaints from the inhabitants of the neighborhood. Sometimes 20 or 30 years have elapsed without anything more than this piecemeal procedure, or any attempt at renovating the road right across from gutter to gutter. The outside edges were not touched at all. The road was scraped in muddy weather, and it frequently happens that more has been taken off the road in the form of mud than has been put on in the form of metal. So that, in course of years, the actual level of the road has lowered some inches. In many parts of Wiltshire where the soil is marly, and also in Devonshire where it is red, the characteristic color of the subsoil appears at the sides of the road—showing that the scant dressing of metal is sinking. When the rainy weather comes the mud is scraped off, and nothing is put on to take its place. The effect of this action going on for a long period of years is unfortunate for the gas company. The main pipe, originally laid at the usual 18 inches clear depth, comes within about a foot of the surface. Service pipes laid across the road begin to show up through the ground in the vicinity of the gutter on the other side, and though originally connected by bends tapped in on the top of the main, it is found that they must be put into the side if a proper fall is to be maintained. I have seen old main pipes in which all the services had been transferred from the top to the side for this reason. If they had been originally laid in this position, it is obvious that the services would have been tapped into the sides in the first place. I have seen service pipes showing in the gutter in places where they were certainly well out of sight a few years ago. This state of things is unfortunate for the gas company in two ways. It greatly increases the risk of injury and damage to their plant; and it subjects them to the unjust accusation of negligence in laying their pipes in the first place. Whether a sufficient period has elapsed to allow denudation to obtain to any great extent, or whether the supply of road metal has been sufficient to compensate for the scraping to which the road has been subjected, the result is the same. There is a layer of road metal or stone—thickest in the center, tapering out to almost nothing at the edges—resting on a more or less sodden and unstable subsoil, and having a rough approximation to the horizontal in cross section.

If a modern road surveyor comes down upon a road in the condition above indicated, with his 10, 15 or 20-ton roller, and sets to work to convert it into a consolidated, bow shaped with clearly marked gutters and regular surfaced road, the result is a considerable displacement of the soil. The cumbrous implement plows its way along, making a wave-like depresion as it goes; and the adjacent surface shakes like a jelly. The surveyor is rather pleased at this displacement than otherwise, as it enables him to attain the desired end with a minimum of new metal. The center is made up first and kept at about the normal level, and the sides and gutters are simply forced down. The ground near the gutter, carrying only a thin layer of metal, will give to any extent, especially if there is nothing to confine it outside. There is not only downward but also lateral displacement under the footpath. I have seen a granite footway curbing forced out of the perpendicular and turned in over the gutter, leaving cracks an inch or more in width on the footpath, and also the footway heaved in great bulges, where the roller had been put upon a badly made and badly kept road. The roller has cost a considerable amount, and is expected to show some economy in material; and therefore there is every inducement to follow this way of procedure, rather than to give the thoroughfare a good dressing of metal from gutter to gutter.

Most of these roads have been provided with gas and water mains and a sewer, all of which have been laid before the making of the road was complete. The sewer has been laid in the center of the road, at a sufficient depth to get the necessary fall from the houses, which will not be less than 6 feet. The water pipe is well away to one side, and laid a good 2 feet 6 inches deep. And then the gas pipe comes somewhere near the gutter, and has been laid at a clear depth of 18 inches, in accordance with the usual practice. If the water main belongs to the local authority, the gas company have no choice but to accept this position. Bearing in mind the foregoing remarks on the effect of the roller when out of the horizontal, and also on the displacement of the soil, it is easy to see why the gas pipes suffer more than the water or the sewer pipes. They are just in the place where the soil is weakest, and consequently the displacement is greatest; and they are probably the only line that experiences the full effect of the lateral as well as the downward strain. In addition to the natural weakness of the subsoil, there are places where the ground under the gas main has been disturbed for sewerage or water purposes.

There is also a tendency to increase the weight of the roller. Most surveyors have a suspicious leaning towards the 20-ton implement; nor is there any guarantee that they accept this as the maximum, except the fact that the breaking load of the bridges in the neighborhood is being approached. If a much heavier load is tried, it may be expected to crush through some bridge and fall into the river, and many gas engineers would not object if there were a few weak bridges in their districts. But however that may be, it must be acknowledged that gas companies only occupy the roads by sufferance, and that the authorities are quite entitled to roll as much as they like. With regard to pipes already laid, the gas company are entitled to some sympathy. They provided for every known contingency, and used every reasonable care, and it is their misfortune and not their fault that the roller has subsequently come upon the scene. But although they could not possibly have provided against the roller in bygone days, the case is different now; for it behooves every gas engineer, when arranging for laying new lines of main, to consider the necessary means for securing himself from trouble and loss by the action of the roller. With regard to pipes already in the ground, it is a matter for good feeling between the road men and the gas works' employees, who should co-operate to avoid damage as far as possible, or to minimize the risk of loss or accident when this has really occurred. But in laying new pipes, care should be taken to keep away from the gutters. The time-honored 18 inches clear must give place to a depth based upon particular circumstances in

each case; and the "gas section" may be discarded in favor of "water section." When iron was £20 per ton, this was an important matter; but now that main pipes are delivered in many districts for less than £5, the additional weight is not a serious item. The small pipes are also weaker than the larger. A 3-inch pipe breaks more readily than a 4-inch one, and a 4-inch goes sooner than a 6-inch. So that, in addition to the usual arguments in favor of pipes of ample size, there is the consideration that the larger pipe is the stronger. Tapping 3-inch or 4 inch pipes for services is also a considerable source of weakness. A 1 inch service in a 4 inch pipe means cutting out about one-eighth of the total section. Boss-pieces should be used for 1-inch or larger services; and in any case the junction may be strengthened by saddle pieces or clips. The substitution of "water section" for "gas section" may also be extended to the wrought iron service pipe. And in the case of new roads consisting of made or otherwise soft ground, it is better to let the roller have a few preliminary trips over the site before laying the gas main.

The Practical Use in the Chemical Laboratory of the Electric Arc Obtained from the Low Potential Alternating Current.

By Mr. Milo S. Walker, of the Racine (Wis.) High School.

In this paper the author does not claim to have discovered any action of the electric arc that is not already known to chemists, but he will attempt to give a few suggestions as to the the way in which the highest temperature at our command can be obtained and used in every chemical laboratory supplied with a fixture for incandescent lighting. Many colleges and secondary schools are equipped with these fixtures, and others can obtain them at but little cost. There is no practical reason why they should not be used for some experiments that cannot be performed with a Bunsen burner or a blow-pipe.

The alternating current of about 50 volts and 1 to 5 amperes, now generally used for incandescent lighting, furnishes an excellent arc for chemical experimentation. It is very efficient and can be handled easily and safely even by beginners in laboratory work.

The apparatus required consists of an iron or wooden stand, a screw clamp like those used for holding burettes, insulated copper wire, some electric light carbons, and a rheostat.

A piece of the so-called 10-ampere flexible lamp cord may be connected at one end with a plug set into the socket intended for an incan descent lamp. The two parts at the other end of the twisted cord are left free. Besides the lamp cord, two pieces of ordinary insulated copper wire of medium size (about No. 20) and 70 cm. long will be needed. These wires can be supplied and fixed as directed by any dealer in electrical supplies.

The rheostat is the most important part of the apparatus. Any commercial rheostat capable of carrying 12 amperes will answer all ordinary purposes. It may be necessary in large buildings where one trans former supplies 100 lights or more, to use an additional resistance. About 40 feet No. 13 German silver wire has been found very satisfac tory in a building where 175 lights are used.

The adjustable rheostat is essential to the proper control of the current, and to prevent too high heating of the wires and consequent melting of the safety fuses when the arc is started. All the experiments are started with a high resistance, which is lessened until the proper arc light is obtained.

The assorted carbons are ¼ to ½ inch in diameter. The cored carbons are much better than the uncored ones. For obvious reasons "coppered" carbons should not be used. Carbons differ much in quality. Some contain considerable quantities of carbides and carbonates of metals. Those manufactured for use in optical projection usually contain less of these substances, and give the best results.

The operator should not touch any metallic fixtures connected with the earth while he is working with the apparatus, as serious shocks may be received if the transformer is not properly insulated—a defect not uncommon in electrical work. It is better to work at a table on which there are no gas or water fixtures. Gas should be conducted to the table by a rubber tube connected with a gas cock so far removed that there is no danger of touching any part of the apparatus and the gas cock at the same time. There seems to be no other danger in working with the 50 volt alternating current. The students working in this laboratory sometimes receive shocks, but they generally consider shocks less disagreeable than accidental burns incident to work in general chemistry.

The electric arc can be used for the following purposes:

1. To show the effect of high temperatures upon difficultly fusible and "non-volatile" substances.
2. For reduction of oxides of metal.
3. As a partial substitute for the blow-pipe in qualitative analysis.
4. For the synthetic preparation of some compounds of carbon from the elements.

There is a wide range of experiments showing the effect of the electric arc upon substances almost infusible by other means.

The apparatus can be arranged in a variety of ways, depending upon the experiment. For general use it may be arranged thus: Fasten a cored carbon about 10 x 1 cm. in a vertical position, so that the lower end is about 10 cm. from the top of the table. Connect by wrapping with insulated copper wire, stripped where contact is made with the carbon. Bore a conical shaped cavity 4 or 5 mm. deep in one end of another piece of cored carbon 4 x 1 cm. Fix into a wooden clamp and connect with insulated wire like the other carbon. On account of the heat, an iron clamp with insulated handle is better for some experiments. Connect all wires so that the circuit will be completed if the carbons are allowed to touch each other. As the light is intense, the eyes should be protected by a dark or blue glass. The longer carbon is stationary. The movements of the shorter carbon are controlled like a test tube and holder. The rheostat should be adjusted so that an arc $\frac{1}{16}$ to $\frac{1}{8}$ inch long can pass between the lower end of the longer carbon and the edge of the conical cavity in the smaller carbon. A small piece of the substance to be tested can be placed in the cavity. Most minerals and common metals fuse easily. A piece of quarts 2 x 1 mm. fuses completely. A piece of the size of a pea fuses on one side.

As this contribution is intended only to show how the electric arc can be obtained and used in a chemical laboratory, a description of experiments is omitted except where they show the method of working. The apparatus has not been in use long enough to show all its possible applications or even a small part of them. But it has been shown that many of the remarkable experiments of Moissan can be repeated on a smaller scale by this simple apparatus. His work suggests much that can be done in the ordinary chemical laboratory lighted by "incandescent lamps."

If iron, copper or manganese ores are placed in the conical cavity, the metals are formed containing small quantities of carbides.

For reduction of oxides it is better to substitute for the solid upper carbon, a carbon tube made by removing the core from the "cored carbon" 3 or 4 cm. long. This tube is then fastened into a brass tube of about the same outside diameter, but with a large bore. The joint can be made gas-tight by a paste of pure graphite and water. The brass tube is fixed and connected with wire like the upper carbon in the other apparatus. The end of the carbon tube should occupy the position of the lower end of the larger carbon as indicated above. Now a gas can be passed through the carbon tube so that it will strike a substance in the cavity of the small carbon, while the arc is passing. Hydrogen or coal gas may thus be conveniently used to prevent oxidation of metals while cooling, and seem to assist in reducing oxides and chlorides while the arc is passing. If carbon dioxide is used, carbon monoxide is formed with apparent increase in the reduction of oxides. In all these experiments a crater is gradually formed, and the arc generally passes from the inside of the carbon tube, thus giving maximum efficiency. When oxygen is used, the crater forms rapidly and enlarges to the full diameter of the carbon. Carbon monoxide is the main product of the quite rapid combustion, and acts as a powerful reducing agent upon an oxide in the cavity of the other carbon. By reducing with carbon monoxide in this way and cooling in hydrogen, quite pure manganese has been obtained from pure manganese dioxide. Similar experiments with oxides of other metals will be tried as soon as pure materials are secured.

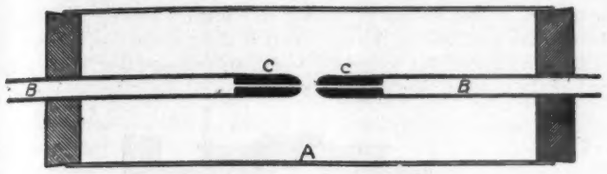
Experiments with the electric arc are particularly interesting to the student, because he is able to get quick, sharp and definite results. The manipulation is so easy that young students can obtain beads of copper, iron or manganese after a few minutes' practice. The electric arc has been used in this laboratory as an aid in qualitative analysis and a partial substitute for the blowpipe, but the method will not be described at present because it has not been sufficiently tested. A special apparatus has been used in which the electric arc is inside a partially closed glass tube, and the volatile constituents of the substance to be treated are collected and partially separated on the sides of the glass. The results so far obtained are very satisfactory.

Some experiments on the synthesis of the hydrocarbons from their elements have been tried. Thus acetylene is easily prepared by the method of Berthelot[1] modified by Dewar.[2]

1. Compt. Rend., 54, 640. 2. Proc. Roy. Soc., 29, 188.

The apparatus may be made as follows:

Fit a gas tight cork into each end of a straight lamp chimney. Pass brass tubes 1 cm. diameter and 15 cm. long through each cork. Into



one end of each tube fix a tube of carbon 3 cm. long, prepared and fitted as shown under experiments for reduction of oxides. The joints of carbon and brass tubes should be gas tight.

Fit the corks and brass tubes so that the ends of the carbon tubes are nearly together, test the apparatus for gas leakage, turn on the current and again test after the heat has reached a maximum. If air tight pass a stream of hydrogen through the brass and carbon tubes. After the oxygen in the apparatus has been consumed it may be necessary to increase the current.

As there is nitrogen from the air in the apparatus small quantities of hydrocyanic acid are formed at first along with acetylene. The yield of acetylene is not large, but the method seems to be fully as satisfactory as the usual laboratory method of preparation of this gas from coal gas by burning it in an insufficient supply of air. This is recommended as a laboratory method for students. It is the only experiment showing synthesis of carbon and hydrogen from the elements, and the construction and manipulation of apparatus are not too difficult for any one who has had a few weeks' experience in a laboratory.

Supporting Power of Piles.

By Mr. Franz Kreuter, C.E., Munich.

It is often impossible to test bearing piles by the direct application of a sufficient load, and the supporting power can then be ascertained only by means of certain formulas, either rational or empirical. The most noticeable among the former are those of Redtenbacher and of Rankine. All the formulas hitherto proposed, however, are defective, and this deficiency is chiefly due to the following uncertainties:

1. The blow or concussion between the hammer and the pile is usually, for safety, supposed to be inelastic; but this is obviously not the case. The allowance, however, which should be made for the elasticity of the blow is unknown.

2. It is not certain whether, as being compressed by the action of the blow, a length equal to the whole actual length of the pile or to some part of it only should be introduced. Redtenbacher in his formula inserts the whole, Rankine only one-half, of the real length of pile.

3. The weight of the timber of which the pile consists, and which is introduced into Redtenbacher's formula, varies for pine between 30 pounds and 44 pounds per cubic foot.

4. The modulus of elasticity of pine may vary between 1,400,000 pounds and 1,800,000 pounds per square inch.

These formulas in consequence differ widely in their results. Other formulas in which the compressibility of the timber is neglected are to be condemned as being apt to lead to serious errors in all cases, unless the influence of the elasticity of the timber is inappreciable. This only occurs when a comparatively light pile is driven into soft ground by heavy blows. The empirical formulas are in most cases merely based upon conjecture rather than upon reliable observation, for the reason that the real supporting power of bearing piles cannot always be tested by the application of a sufficiently large dead load. On the most favorable assumption they will be approximately correct only for cases similar to the one from which they have been deduced, and their generalization will always be open to suspicion. They are therefore still less trustworthy than rational formulas.

The author proposes to show a new method, at once simple and reliable. The supporting power is generally required only when the pile has been already driven into the ground to a considerable depth, and sinks comparatively very little further after a certain number of subsequent blows or set of blows. It may in that case be concluded that when the penetration of the pile after a blow has become very small in comparison to the total depth already attained, the increase of supporting power will be also small in comparison with the total supporting power it already possesses.

Now, let W be the weight of the hammer and h the height from which it falls, then

$$E = W h. \quad \ldots\ldots (1)$$

gives the energy of the blow or set of blows, as the case may be. This energy is spent in producing a number of different effects, which, however, may be summed up in two classes, one of which represents the useful work, while the other comprises all that work which is of no use for the particular purpose, and which may therefore be regarded as lost. Let the former be expressed by U and the latter by V, then it is evident that

$$E = U + V.$$

U only represents the work done in driving the pile against the resistance of the ground through a measurable distance or depth d; and this resistance of the ground to the penetration of the pile is the bearing power of the latter L; therefore,

$$E = L d + V \quad \ldots\ldots (2)$$

The hammer only does useful work from the moment when the pile begins to move, or a soon as

$$d > 0.$$

As long as d remains zero all the work done by the hammer is useless or lost. Let E_0 be the energy necessary to balance the loss V at the limit when the pile will just begin to penetrate further; then,

$$V = E_0.$$

If now the value E be found, beyond which the loss V cannot increase—because for any value of $E > E_0$ the resistance of the ground is overcome and the pile will penetrate—it follows directly from (2) that

$$L = \frac{E - E_0}{d} \quad \ldots\ldots (3)$$

It is true that E_0 cannot be determined in a direct manner, but it may be deduced with sufficient accuracy from the result of two subsequent blows, or sets of blows, in the following manner: Make two consecutive and efficient sets of an equal number of blows, but of different energies, E_1, E_2; that is to say, in using the same hammer apply different heights, h_1, h_2. If the pile still advances considerably let the blows of the second set be the weaker; if the advance of the pile is small let the second set of blows be the heavier. Let d_1, d_2 be the depth through which the pile is driven by the action of the energies E_1, E_2 respectively; then, subject to the conditions that d_1 as well as d_2 be sufficiently small in comparison with the whole depth already attained, it may be assumed that L as well as V will remain sensibly constant in passing from the first set of blows to the second, so that from (2) it may be deduced

$$\frac{d\ (E)}{d\ (d)} = \text{constant, nearly.}$$

The law according to which E and d vary together may therefore in this case, and within the limits in question, be approximately represented by a straight line, inclined towards the rectangular axes of coordinates and intersecting one of them in the point corresponding to

$$d = 0,\ E = E_0;$$

so that—

$$\frac{E_1 - E_0}{E_2 - E_0} = \frac{d_1}{d_2}.$$

whence—

$$E_0 = \frac{E_2 d_1 - E_1 d_2}{d_1 - d_2} \text{ nearly} \quad \ldots\ldots (4)$$

If now in (3) and (4) the number of blows used in the testing set be canceled, the equations may take the form—

$$L = \frac{h - h_0}{D}. W \quad \ldots\ldots (3a)$$

$$h_0 = \frac{h_2 D_1 - h_1 D_2}{D_1 - D_2}. \quad \ldots\ldots (4a)$$

where D is the average depth through which the pile is driven by one blow of the respective set of blows.

Since for h and D in (3a), h_1 or h_2 and D_1 or D_2 respectively, may be substituted, the bearing power of pile may be finally expressed—

$$L = \frac{h_1 - h_2}{D_1 - D_2}. W \quad \ldots\ldots (5)$$

This method is more reliable than any other, dispensing, as it does, with all uncertain assumption and being merely founded upon observations in connection with the special case in question.

Preparatory to ascertaining the supporting power of piles by the method explained, the following precautions are of great importance:

1. The piles should rest for some time in order to allow the stresses produced in the ground by the penetration of the piles to be relieved. It has been stated from experience that piles frequently penetrate with

renewed ease after some days' rest. An immediate test-driving might therefore lead to erroneous results and to too high an estimate of the supporting power of the piles.

2. The heads of the test-piles should be sawn off to present a sound and solid surface to the blows of the hammer.

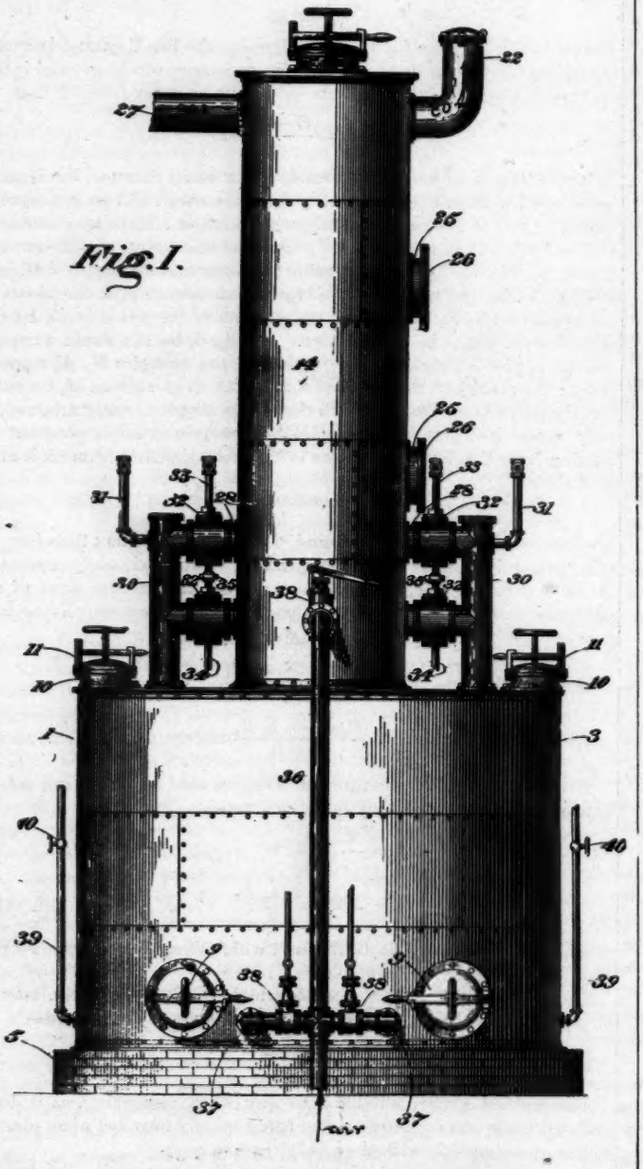
3. The number and force of the testing-set of blows should be such as not to crush the head of the pile.

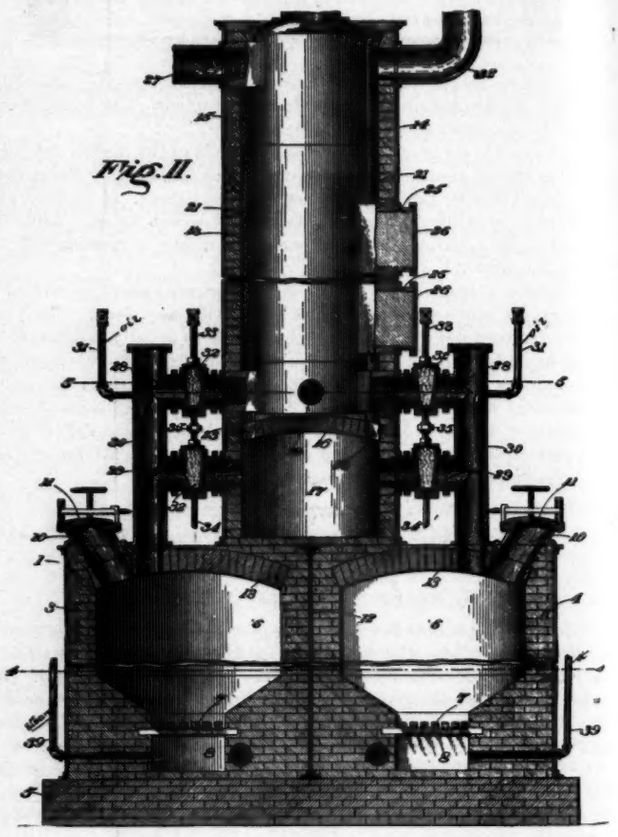
The Waters Gas Manufacturing Apparatus.

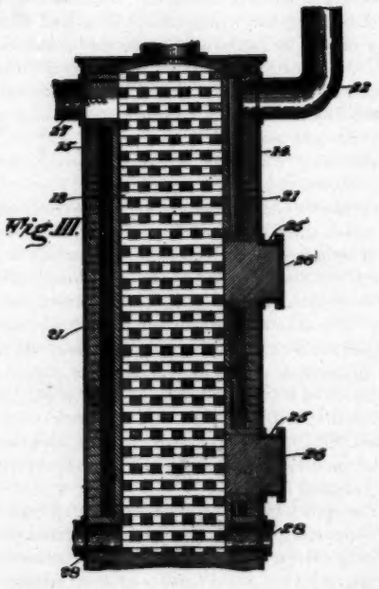
On February 11th, 1896, U. S. Letters Patent (No. 554,326) were issued to Mr. John A. Waters, Assistant Superintendent of the Stamford (Conn.) Gas and Electric Company, for "improvements in apparatus for the manufacture of gas." Using the words of the specification:

The object of my invention is to produce improved apparatus for the manufacture of gas, especially of the kind known as "water gas," either for fuel or illuminating purposes, whereby its productive operation is made practically continuous and with great economy of time and fuel.

Heretofore in one method of manufacturing water gas it has been customary to employ a single generator and fixing chamber or regenerator, the plan of operation being to reduce a mass of carbon in the generator to an incandescent state and heat the regenerator until the refractory material which it contains is raised to the required temperature. Then, by supplying steam to the generator, its decomposing gases, commingling with carbureting material, are conducted to the regenerator and there rendered homogeneous or fixed. In the manufacture of gas by this process a very high heat in both the generator and the regenerator is necessary, and consequently the actual period of gas production by the use of such former apparatus is limited. Among the reasons therefor are that, during the early part of the gas making process, the carbureting material is converted into lampblack and that, in the latter part of the process, the regenerator being cooled, the gases are not properly fixed and fall away. Consequently in the use of such other apparatus it becomes necessary to reheat the generator and regenerator as before, an operation which must be repeated after each gas making period. The consequences of this process by old methods are a great waste of fuel and carbureting material and the production of an unsatisfactory



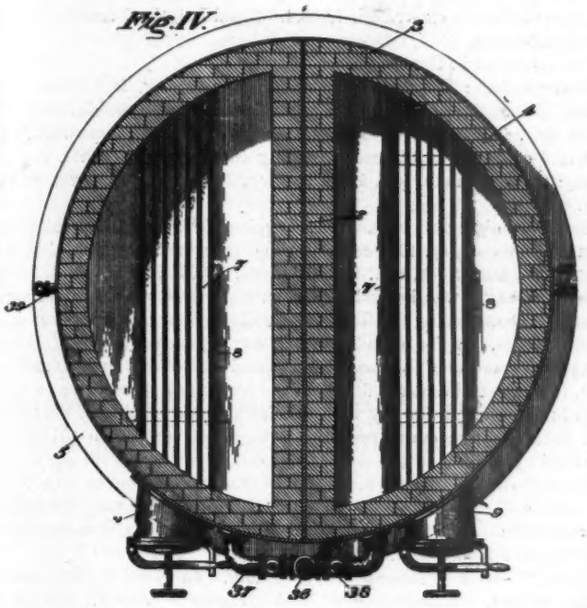


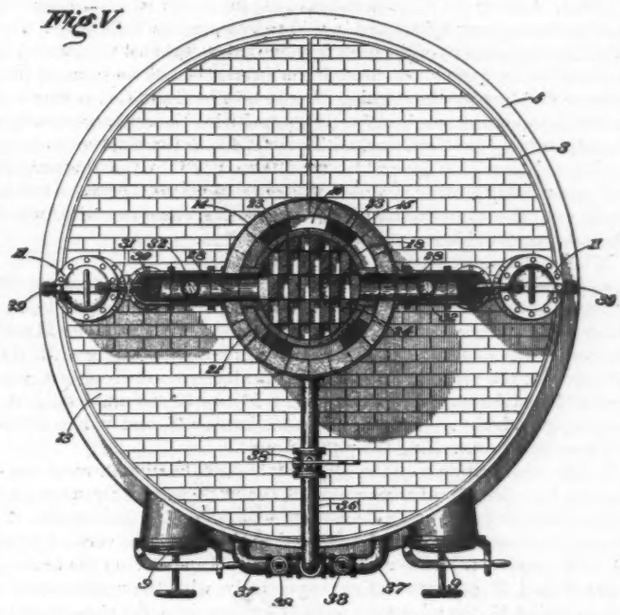


gas. By my invention these objections are overcome, and I have produced an apparatus adapted to make a throughly fixed, non-condensable gas by a practically continuous operation and with a minimum consumption of fuel and carbureting material.

In the accompanying drawings, Figure I. is a side elevation of the complete apparatus. Fig. II. is a central vertical section thereof with the regenerator shown in elevation. Fig. III. is a view of the regenerator heating chamber, showing also the regenerator in section. Fig. IV. is a section on a line 4 4 of Fig. II., and Fig. V. a section on the line 5 5 of Fig. II.

Referring to the figures on the drawings, 1 indicates the exterior generator wall of the apparatus, which is preferably cylindrical, and is composed preferably of a metal casing 3 and an interior lining of firebrick 4, the whole being sustained upon a suitable foundation 5. Within the generator walls are two entirely separate and independent generator chambers 6, of suitable shape and dimensions, provided, respectively, with grate bars 7, ashpits 8, and doors 9 in the lower part, and in the upper part with fuel supply inlets 10 provided with suitable self-sealing doors 11. They are separated from each other by a metal partition and by intermediate fireproof walls 12, of suitable thickness, and are, respectively, provided with arched roofs, 13. The walls 12 and the arches 13 should be specially constructed of sufficient strength to support a superimposed regenerator heating chamber composed of an exterior metallic shell 14 and an interior lining 15 of firebrick. This regenerator heating chamber is preferably cylindrical. A special purpose of building it above the generators is to make the line of draft from the generators to the regenerator heating chamber as direct as possible for both of the generators.





16 indicates an arch, which defines below it a combustion chamber 17 and supports above it a regenerator or fixing chamber 18, preferably built in sections, as indicated by lines in the drawings, of fireclay. The outside diameter of the chamber 18 is considerably less than the inside diameter of the regenerator heating chamber, and the former is coaxial with the latter, so that an annular flue 21 surrounds the regenerator and affords free egress on all sides thereof for the ascent of the products of combustion from the combustion chamber 17 to a stack 22, which may be provided with a cap, as shown, communication between the combustion chamber and the flue 21 being established by a series of openings 23 in the arch 16 adjacent to its periphery. The interior of the regenerator is in practice filled with the usual checkerwork or other refractory material 24 common in regenerators.

Ports 25, that constitute branches of the walls of the regenerator, project at intervals through the walls of the regenerator heating chamber and afford means for supplying or removing the checkerwork material to or from the interior of the regenerator. These ports are closed by plugs of firebrick and by suitable doors 26.

A gas outlet 27 communicates through the walls of the regenerator heating chamber with the interior of the regenerator near its top. Supply inlets 28 communicate, respectively, in like manner with the interior of the regenerator near its bottom, and similar inlets 29 communicate, respectively, with the interior of the combustion chamber 17. An inlet 28 and an inlet 29, respectively, establish communication preferably through a pipe 30 with one of the generators 6, a separate pipe and a pair of inlets being provided for each of the generators. Each of the pipes 30 should be arranged to open through the roof 13 of its generator near its middle, not only to afford ready means of egress of the products of combustion from the generator, but also in order that an oil supply pipe 31, adapted to discharge carbureting material from a source of supply (not illustrated) to the interior of the pipe, may discharge it well into the body of the generator.

Suitable valves 32, preferably water cooled, as by water supply pipes 33 and 34, are located in each of the inlets 28 and 29, respectively, and are adapted, by suitable operating mechanism 35a, to independently control the passages afforded through the respective inlets.

35 indicates a ball joint independently connecting the intermediate supply pipes of the valves 32.

Suitable provision for supplying forced draft to the interior of the ashpits 8 and the combustion chamber 17, respectively, is afforded by means of a blast pipe 36 and its branches 37, that communicate with a source of air supply (not illustrated). The pipe 36 and its branches 37 are, respectively, controlled by valve operating mechanism 38 of any suitable and ordinary construction. Each of the generators is provided with a steam pipe 39 communicating, respectively, with a source of steam (not illustrated), and which gains access to the interior of the generators through the walls thereof, and preferably enter beneath the grate bars.

A valve 40 in each of the pipes 39, respectively, controls the passage of steam through it.

The operation of my apparatus is as follows: The generators are first filled, through the inlets 10, with coke, coal, preferably anthracite, or any other suitable fuel. The valves in the inlets 29 are opened and the fuel in the generators is ignited. An airblast is then supplied from the branch pipes 37 and the pipe 36. The products of combustion from the body of fuel in the generator passing up through the inlets 29 enter the combustion chamber 17, where combustion is completed by the secondary air discharged therein through the pipe 36, and, passing upward outside of the regenerator 18, raise the temperature thereof and of the checkerwork within it to the required temperature. Under certain conditions, as in beginning the operation of my apparatus, it may be desirable to heat the regenerator by special means. I therefore provide for the chamber 18, near its bottom, an air inlet 19, through which secondary air may be admitted to the interior of the regenerator for converting the lower part thereof into an auxiliary combustion chamber. By the time the fuel in the generators is rendered incandescent the regenerator and its contents will have been properly heated. Thereupon the valves in the inlets 29 are closed and the valves in the adjacent inlets 28 are opened. Steam is then admitted by the operation of the valves 40 and is discharged into the incandescent mass of carbon in the gener-

ators. The hydrogen and carbonic oxide, decomposed by the action of the heated carbon from steam, pass upward through the pipes 30, commingling with the carbureting material discharged from the pipes 31, and, passing through the heated checkerwork of the regenerator, are discharged as a stable, fixed and clean gas through the outlet 27. This process is continued until the gas making period of the one generator has altogether or nearly expired, when the valve in the inlet 28 on one side is closed, the operation of the other generator being continued. One generator may be filled or refilled with fuel while the other is in operation. In this manner, after the initial heating, there is practically no loss of fuel during the time of preparation for each gas making period, and the periods of gas making are practically continuous. Moreover, by providing two separate conduits for the products of combustion and the gas, pollution of the checkerwork, that is consequent upon the passage of the products of combustion through it, is entirely avoided. The checkerwork is kept clean, in the best operative condition, and all loss either in time of operation or quality of the gas produced is eliminated.

I do not confine myself to the details of construction herein shown and described, but reserve the right to modify and vary them at will within the scope of my invention.

I am aware of Patent No. 512,950, dated January 16, 1894, for apparatus for distilling or gasifying hydrocarbons, said apparatus being particularly designed with a view to prevent the loss of aromatic hydrocarbons. Among the characteristics of my invention which distinguish it from the apparatus disclosed in said patent are the following: The relative arrangement of the parts is such that no exhaust mechanism is required to draw the gases through the apparatus, and no separate furnace or fireplace for the burning of coke or other solid fuel is required to maintain continuous heat for the gases during their passage through the apparatus. Furthermore, with my apparatus the blast gases may be directed from both generators simultaneously into the regenerator and regenerator heating chamber, while in said patent the valves necessarily cut off communication from one of the chambers A^1 A^2 when opening communication with the other.

What I claim, broadly, is:

1. In gas making apparatus, the combination with the generators 6 6 of the superimposed combustion chamber 17 and regenerator 18, the latter being surrounded by the annular flue or heating chamber 21 and the roof of the chamber 17, having openings communicating with the chamber 21, the vertical pipes 30, each opening from the roof of a generator 6 and having the branch pipes 28 and 29 communicating respectively with the regenerator 18 and chamber 17, and valves 32 for independently controlling the pipes 28 and 29.

2. The combination with the generators 6 6, of the superimposed combustion chamber 17 and regenerator 18, the latter being surrounded by the annular flue or heating chamber 21 and the roof of the chamber 17, having openings communicating with the chamber 21, the vertical pipes 30, each opening from the roof of a generator 6 and having the branch pipes 28 and 29 communicating respectively with the regenerator 18 and chamber 17, the oil supply pipes 31 leading into the pipes 30, and valves 32 for independently controlling the pipes 28 and 29.

3. The combination with the generators 6 6, of the superimposed combustion chamber 17 and regenerator 18, the latter being surrounded by the annular flue 21 and the roof of the chamber 17 having openings communicating with the chamber 21, the vertical pipes 30, each opening from the roof of a generator 6 and having the branch pipes 28 and 29 communicating respectively with the regenerator 18 and chamber 17, valves 32 for independently controlling the pipes 28 and 29, and the air blast pipes 36 and 37 for supplying air to the ashpits of the generators and to the chamber 17.

4. The combination with the generators 6 6, of the superimposed combustion chamber 17 and regenerator 18, the latter being surrounded by the annular flue or heating chamber 21, and the roof of the chamber 17 having openings communicating with the chamber 21, the vertical pipes 30 each opening from the roof of a generator 6 and having the branch pipes 28 and 29 communicating respectively with the regenerator 18 and chamber 17, the valves 32 for independently controlling the pipes 28 and 29, and the air supply or inlet 19 for admitting secondary air to the bottom of the regenerator 18.

Cost of Pipe Laying.

"G. W. S.," submits the following memoranda to *The Technic* respecting "Costs of Pipe Laying" obtained by him during the summer of 1893:

Case I.—Pay of laborers, 15 cents per hour; pipe handlers, 16 cents to 17½ cents; foreman, 20 cents to 25 cents. In a paved street. Paving, cedar blocks on plank and sand. Backfilling all pounded in layers when loose not more than 4 inches thick. Material, mostly clay; a few feet of sandy loam. Depth of trench, 4 to 5½ feet. Size of pipe, 24 inches, laid on 4 x 4 inch blocks. Specials about every 300 feet. Length of line, 2,500 feet. Total of connections: 12″ = 56′; 10″ = 14′; 8″ = 27′; 6″ = 89′; 4″ = 21′. Estimated = 2,550 feet of 24-inch pipe.

Estimated earth excavated, 2,709.4 cubic yards.

Cost per foot: Digging, 27.25 cents; pipe laying, 24.80 cents; bell holes, 15 cents; shoveling in, 17.9 cents; pounding 79.27 cents; loading earth, 8.95 cents; teaming earth, 6.36 cents; total, $1.7953.

Cost per cubic yard: Digging, 25.62 cents; shoveling in, 16.84 cents; pounding, 74.61 cents.

Surplus earth was hauled at 17 cents per load of 1.4 cubic yards loose.

Case II.—In an unpaved street. Backfilling for 1,356 feet done by laying tiles, two lines, one of 4 inch at bottom of trench and one of 3 inch at half the depth, both connected to sewers, and filling in layers, 12 inches to 20 inches thick, each thoroughly slushed from above before next was put on to within 6 inches of top. Top, 6 inches, thoroughly pounded after bottom had dried at least 24 hours.

The remaining 790 feet filled as above. Material as above.

Total length of 24-inch pipe, 2,032 feet. Total of connections: 12-inch = 19 feet; 8″ = 32′; 6″ = 99′; 4″ = 21′. Estimated = 2,100 feet of 24-inch pipe.

Estimated earth excavated, 1,963.4. Total length of trench dug and filled, 2,200 feet.

Other data as in Case I.

Cost per foot: Digging, 33.3 cents; pipe laying, 18.2 cents; bell holes, 12.8 cents; shoveling in, wet, 19.1 cents; pounding, wet, 10.7 cents, dry, 46.4 cents; tile (including cost of tiling), hose work, etc., wet, 7.4 cents, dry, 2.1 cents; loading earth, wet, 4.6 cents, dry, 4.4 cents; teaming earth, wet, 5.5 cents, dry, 3.8 cents; total, wet, $1.117, dry, $1.401.

Cost per cubic yard excavated: Digging, 37.3 cents; shoveling in, wet, 21.6 cents, dry, 19.9 cents; pounding, wet, 12.1 cents, dry, 48.1 cents; tile, hose work, etc., wet, 8.4 cents, dry, 2.1 cents.

Surplus earth was hauled at 17 cents per load of 1.4 cubic yards loose. Or considering the filling alone the cost per foot for wet work was 47¾ cents, and for pounding work was 75¾ cents.

As to the results of the backfilling experiment other than the reduced cost, it was found that the filling in the wet way required two to three days longer than in the dry way. So far as the condition of the trench and roadway was concerned in an unpaved street, the filling was rounded up about 4 inches above the grade of the rest of the street both in the wet and the dry work, and this has been sufficient to provide for the settlement in both cases. The dry work shows itself somewhat more smooth than the wet, but hardly sufficiently so to be noticeable in driving over the ground.

Case IV.—Pay of laborers as previously. In paved streets, mainly cedar on sand. Material, clay. Backfilling as in Case I. Line composed of 24″ = 17′; 16″ = 4,121′; 12″ = 1,615′. Connections, 12″ = 10′; 10″ = 25′; 6″ = 179′; 4″ = 195′. Estimated = 6,241 feet 12 × 15-inch pipe.

Cost per foot: Digging, 20.60 cents; pipe laying, 20.89 cents; bell holes, 9.54 cents; shoveling in, 12.28 cents; pounding, 28.96 cents; loading earth, 3.58 cents; teaming, 6.35 cents; total, $1.0318.

Cost per cubic yard. Digging, 37.36 cents; shoveling in, 22.26 cents; pounding, 54.34 cents.

Estimated excavation, 3,441 cubic yards. Surplus earth hauled at 40 cents per load.

Case V.—Pay of laborers as above. In unpaved streets, back filling, wet, as in Case II. Material, clay. Pipe, laid on blocks. Other data as previously. Size of pipe, 10 inches. Connections, 4″ = 98′; 3″=4′. Estimated = 8,969 feet of 10-inch pipe. Estimated excavation, 4,508 cubic yards. Earth pounded on top and for street crossings, 1,376 cubic yards.

Cost per foot: Digging, 24.16 cents; pipe laying, 9.39 cents; bell holes, 0.98 cent: shoveling in, 13.60 cents; pounding, 13.22 cents; tile (including cost thereof), hose work, etc., 2 cents; loading, 0.52 cent; teaming, 0.46 cent; total, 64.33 cents.

Cost per cubic yard: Digging, 48.07 cents; shoveling in, 27.06 cents: pounding, 86.18 cents.

Surplus earth hauled at 17 cents per load.

On this work great pains was taken with the grading of the tile, one row being at the bottom and another half way up, and all were connected to sewers. As a result, from the time the work was completed

the ditch has been the best part of the street, and especially so in muddy seasons.

In the above memoranda there are developed some relations between earth in the ground and in wagon boxes.

In Case I., of 24-inch pipe, the pipe volume was about 110 cubic yards, but the quantity of earth hauled away from the trench by wagon load measurement was about 1,300 cubic yards, or 2,709 cubic yards, swelled 1,190 cubic yards in handling, amounting to about 44 per cent.

In Case II., of 24-inch pipe, the pipe volume in slush work was about 55 cubic yards, and there was hauled about 611 cubic yards of surplus. For the pounded work the pipe volume was about 28 cubic yards, and the surplus about 252 cubic yards. Or the amount of the swelling in the former instance was 556 cubic yards in 1,200, or about 44½ per cent., and in the latter it was 224 cubic yards in 763, or about 30 per cent.

In Case IV., of 16 inch and 12-inch pipe, the pipe volumes were about 355 cubic yards and the surplus was about 1,030 yards. The swelling, therefore, was 675 cubic yards in 3,441 cubic yards, or about 20 per cent.

Case VI.—Laborers paid $1.25 for eight hours. In a paved street. All back filling pounded, Connections every 300 feet. Size of pipe 12 inches. Length of line 1,048 feet. Depth 5 feet.

Cost per foot: Digging, 18.6 cents; laying, 25.7 cents; filling, 45 cents; hauling surplus earth, 1.4 cents; total, 90.7 cents.

Case VII.—Same as above except length = 2,475 feet.

Cost per foot: Digging, 13.4 cents; laying, 16.2 cents; filling, 39 cents; hauling surplus earth, 1.1 cents; total, 69.73 cents.

Case VIII.—Same as above, except size = 10 inches, and length = 2,592 feet.

Cost per foot: Digging, 19.20 cents; laying, 12.18 cents; filling, 39.49 cents; hauling surplus earth, 1.01 cents; total, 71.88 cents.

Case IX.—Same as above, except size = 8 inches, and length = 2,049 feet.

Cost per foot: Digging, 14.42 cents; laying, 6.78 cents; filling, 36.32 cents; hauling surplus earth,——; total, 57.46 cents.

In all of the foregoing each connection made was with a line already in service, and therefore involving a more or less complicated shut-off. Besides this, in almost every case, there was a pre-existing pipe which had to be removed. In cases I. to V. inclusive a record of the cost of this labor was kept and deducted, but in the remaining cases no account was taken of it either way.

Judge Clark's Decision on the Plea of the New Memphis (Tenn.) Gas and Light Company for an Injunction to Restrain the Authorities from Enforcing an Arbitrary Gas Rate.

Last week we referred to the decision, rendered by Judge Clark, of the Federal Court for the Eastern and Middle divisions of Tennessee, in the matter of the petition of the New Memphis Gas and Light Company for an injunction to restrain the authorities of Memphis from enforcing an "arbitrary and unreasonable" gas rate in that city, and we here give the full text of Judge Clark's opinion:

New Memphis Gas and Light Company vs. The City of Memphis.

The question now considered in this case is whether a preliminary injunction shall be allowed.

This question arises upon bill answer and affidavits in support of the charges in the bill.

The Act of the Legislature of the State, of 1887, chapter 91, confers upon the Taxing District of Memphis the power to regulate gas companies, and also to regulate the price to be charged for gas furnished to the city and its inhabitants, with a provision that it shall not regulate the price below $1.50 per 1,000 feet, when paid within the customary discount days.

Pursuant to this legislative authority the Taxing District by ordinance, 1895, October 29, undertook to exercise the power of regulation by reducing the price of gas from $1.75 per 1,000 feet, as theretofore charged, to the lowest limit which under the statute it was permitted to go, namely, $1.50 per 1,000 feet. The ordinance was subsequently so amended as to make its violation a misdemeanor and a subject of prosecution.

The substance of the charges made in the bill as ground for an injunction, is that this ordinance is invalid, because the price fixed thereby was arbitrarily done, the Taxing District going to the lowest limit possible, without any method whatever of inquiry to ascertain whether the rate fixed was reasonable, or such as would enable the company to maintain its existence and to make a reasonable profit on the the money invested in the enterprise. Various questions are made in the bill, as well as in the brief as to the constitutionality of the legislative Act and of the ordinance passed under authority of that Act.

So, too, various questions arise as to whether or not the New Gas Company, by virtue of its organization under the Act of 1885, has so connected itself with the contract rights and privileges of the old company under its charter, as to be exempt from regulation, beyond such as might have been had in regard to the old company, and under the original charter of that company.

It is to be borne in mind that it is not proper on application of this kind to decide nor to consider with a view to a final decision, the merits of the controversy, especially where such merits turn on grave questions of law.

It would no more be proper to do so on a motion for an injunction, than on a motion to dissolve an injunction. Owen vs. Brien, 3d Tenn. Chancery, 295.

It is consequently settled that upon preliminary application for an injunction, all that the Judge should as a general rule require is a case of probable right and probable danger to that right without the interposition of the Court, and his discretion should then be regulated by the balance of inconvenience or injury to the one party or the other. 2 Beach on Modern Equity Practice, Section 756; Flippin vs. Knuffle, 2 Tenn. Chancery, 238.

Such being the practice upon this subject, I do not now deem it proper to discuss the more serious legal questions here involved. I think it is safer to make such examination as is now required from the standpoint of the contention made by the able counsel for the Taxing District and determine how far this contention meets the *prima facie* case and in the bill for injunction, and whether such contention offers valid ground for refusing the preliminary injunction.

The defendant's contention is that the New Gas Company became incorporated in 1894, subsequent to the passage of the Act of 1877 authorizing regulation, and that it therefore took its franchises subject to the provision of said Act, and that the ordinance of the Taxing District, although passed subsequent to the incorporation of the new company, was merely in execution of the legislative Act, and is therefore entirely valid, if the Act of Assembly is itself valid.

I think this contention is in the main sound. And I desire to say in passing, that if the new company can so connect itself with the old company as to stand in the shoes of the old company in all respects, I do not think it by any means follows that the company is not subject to regulation as to the price which it shall charge for gas.

It would require provisions in the original charter sufficiently definite to amount to a contract right to exemption from regulation before its claim to this effect could be sustained.

But the real attack made in this bill upon the ordinance in question is not so much that the Act of the Assembly authorizing an ordinance; is, when properly construed and enforced, not valid, but that the ordinance is not a legal and proper exercise of the power conferred by that Act.

The objection is not so much to the legislation on its face, as to the manner in which the Taxing District has undertaken to enforce the act.

The act of the General Assembly is to receive such construction as will render it, if possible, constitutional and valid, and not invalid, and it must be borne in mind constantly that when a corporation is chartered under the general incorporation law with the right to manufacture and sell gas; the right to charge a reasonable rate for all gas furnished is a right implied, and one that forms part of the charter contract with the State, which cannot be impaired by legislation.

And a reservation of the right to repeal, modify, or amend the charter does not change this rule, so long as the State chooses to allow the charter, and the charter rights to remain. Conceding for the present that under this reserved power the State might withdraw the franchises granted, and extinguish the corporate existence; that is not the question here, as the State has not attempted to do anything of the kind, and no attempt has been made to amend or modify the charter. An extinguishment of the charter and of corporate existence, must be distinguished from an unreasonable regulation of the corporation while its existence is permitted by law; and the Legislature would have no more power by an unreasonable amendment of the charter to destroy the Company's business, and thereby destroy its property, which is devoted to and valuable only for its use in the conduct of such business, than it would have to accomplish this result by an independent statute.

The State is under an obligation to act justly and without arbitrary discrimination between corporations of the State, just as it is between citizens of the State, enjoying equal rights.

The State cannot, under the guise of a regulation, bring about a de-

struction and confiscation of a company's property, and the State's power to absolutely abolish the corporation, must be distinguished from its power to destroy its business and confiscate its property, so long as it chooses to permit its existence and to authorize the business by a valid charter—Chicago, M. & St. P. Ry. Co. vs. Minnesota, Minn. R. R. & W. Com., 134 U. S., 418—and this is the fair result of what is now known as the "Reagan cases:" 154 U. S., 362, 420, 413, 418, and the question of the reasonableness of a rate of charge is eminently a question for judicial investigation, requiring due process of law for its determination.

And to deprive a company of the power of charging reasonable rates for the manufacture and sale of gas is to deprive it of the use of its property, and in effect of the property itself without due process of law: Chicago, M. & St. P. R. R. Co. vs. Minnesota, Minn. R. R. Co., supra. The act of assembly under consideration, therefore, must be given a construction which would not render it invalid or obnoxious to constitutional objections, for otherwise the act itself would be void.

It is clear, therefore, that the act in question, in fixing a limit below which the Taxing Districts should not go, did not thereby authorize the Taxing District to reduce the price of gas to that limit arbitrarily.

And the very use of the term "regulation" implies that an investigation shall be made, that an opportunity to present the facts shall be furnished; that when the facts are established, they shall, by the regulating power, be given due consideration, and that such action as shall be taken in view of these facts, thus ascertained, shall be just and reasonable and such as enables the Company to maintain its existence, to preserve the property invested from destruction, and to receive on the capital actually and bona fide invested in the plant, a remuneration or dividend corresponding in amount to the ruling ratest of interest.

The Company has a right to such gross income from the sale of gas, as will enable it to pay all legitimate operating expenses, pay interest on valid fixed charges, so far as bonds or securities represent an expenditure actually made for the Company in good faith, and also to pay a reasonable dividend on stock, so far as this represents an actual investment in the enterprise.

All of these items, and perhaps others, must be taken into account in any regulation which may be made in respect to the prices of gas.

Such investigation and such regulation as is contemplated by the statute, might enable the Company to fix the price at $1.50 per 1,000 feet, or at any named figure between that and the former price of $1.75 per 1,000 feet. This would depend on the reasonableness of the regulation in the sense above explained, keeping constantly in mind that the power to regulate rates is not a power to destroy, and that limitation is not the equivalent of confiscation. It is common for railroad charters to provide that the carrier may charge a rate for transportation of goods and passengers, not exceeding a fixed amount; for example, 5 cents a mile for every passenger. But this is a restriction on the Company itself as to its charges, and it is entirely competent for the Legislature, notwithstanding this provision, to regulate the charges within reasonable limits, and to fix a sum below the maximum, beyond which the Company could not go. Reagan & Buffet vs. Aiken; 9 Lea, 609. Such is the doctrine of the "Reagan cases."

Indeed this is all now very well understood, and is familiar.

So the minimum fixed in this statute, below which the Taxing District cannot go, is a restriction on the Taxing District itself, and a limitation on its power in this respect, and it is compelled to fix a limit above this sum, if it is just and reasonable to do so. Now, if the contention made in this bill is true, the Taxing District, without any inquiry and without any adequate knowledge whatever, and without any effort to know the truth and to do justice, has undertaken in the first instance and by way of arbitrary action to exercise its power down to the lowest possible limit.

So, I repeat, the objection is not so much to anything in the terms of the ordinance, or of the Act of the Assembly, as in the facts which exist outside of the ordinance. If the plaintiffs can, by proof, sustain the charges of this bill, it results inevitably that the ordinance is not a legal and valid exercise of the power conferred on the Taxing District by this statute, but is an attempt to exercise the power in a manner which clearly amounts to destruction, and in such manner, too, as that if the Act of the Assembly had undertaken in terms to authorize it, would render the Act unconstitutional and void on its face.

The distinction is between a valid and just execution of the power given by the Act, and an illegal and unwarranted execution of such power.

The bill charges distinctly that under the rate of charges, as fixed by this ordinance, the corporation would not be able to pay its expenses, interest on its fixed charges, much less a reasonable interest or dividend on its stock, and that an attempt to operate under such a rate of prices would result in its bankruptcy.

And the bill in its main allegations in this respect is supported by affidavits of persons experienced in the manufacture and sale of gas, and some of them, so far as the record discusses, without any interest in this controversy. So that according to the prima facie showing, if the injunction should be refused and the city allowed to put this destructive rate in force, the insolvency and dissolution of this Company would speedily follow. It seems to me clear, therefore, that considering as I must the balance of inconvenience and injury which may result to one party or the other from my action on this injunction pending the litigation, the injunction should be allowed

The public can be protected by a bond in a suitable sum with condition to refund either to the persons who consume gas, or to the Taxing District, for the use and benefit of such persons, all sums which may be charged over the rate fixed by this ordinance, in the event plaintiff's bill shall fail, and the regulation by said ordinance be sustained as valid on final hearing.

It will not be difficult to thus fully reimburse each purchaser of gas for the excess which may be paid over the rates fixed by the ordinance, if finally sustained, and no serious injury can therefore result to the public, while to refuse the injunction would possibly result in the destruction of the plaintiff's business and property before this litigation can be terminated. It is to be observed that this is a bill essentially for preventive relief only, and a denial of the injunction might in its practical effect amount to a denial of all relief. The injunction is therefore granted upon the execution of such bond, and in case the amount thereof is not agreed upon by the solicitors in the case, the amount will be fixed through the aid of the Clerk of this Court upon proper inquiry made by him for that purpose.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Ald. Daniel Davis, who served the Iowa City (Iowa) Gas Company faithfully and well during 20 years as its Superintendent, resigned that post on the 1st inst. Mr. Davis will continue to reside in Iowa City. The Iowa City *Daily Republican*, in announcing Mr. Davis's resignation, had this to say about him: "He has ever represented his employer's interests as earnestly and conscientiously as though he were managing his own business enterprises, and, at the same time, has always been courteous and accommodating to the public."

Mr. Andrew W. De Forrest, President of the New Haven (Conn.) Gas Light Company, has been elected Vice-President of the Tradesmens' National Bank, of New Haven, vice Mr. George A. Butler, deceased.

The following is the text of the report submitted to the City Council, of Norristown, Pa., by its Committee on Law, respecting the proposition to establish and operate a gas works on municipal account in that city:

"*Whereas*, The best interests of the borough of Norristown demand that it should at the earliest possible date construct, maintain and operate a municipal plant for the manufacture, distribution and supply of gas to the public of Norristown for lighting purposes; and,

"*Whereas*, Certain organizations of individuals are applying to the Secretary of the Commonwealth for charters to manufacture and supply gas for light alone, and others to manufacture and supply gas for light, heat and power, in the borough of Norristown, none of which organizations have or have asked for the right to lay pipes or mains through, upon, under or across the streets of said borough; and,

"*Whereas*, The interests of the borough of Norristown would be greatly prejudiced by the grant to any private corporation of a charter which in either form or effect would be exclusive within its territory, and would for a long time or forever prevent the borough from establishing its contemplated plant, even though such private corporation could never use its franchise by reason of the borough's refusal to permit the use of its streets for pipes and mains; therefore, be it

"*Resolved*, That the Watch and Lamp Committee consider and report upon the cost, location and general utility of a municipal gas plant for Norristown; that, pending the final disposition of the subject, and until otherwise ordered, no gas company be granted the use of the streets for pipes and mains; that a standing protest be immediately filed in the office of the Secretary of the Commonwealth at Harrisburg against the grant to any gas company of franchises that will or may be exclusive within the borough of Norristown; and that the Borough Solicitor be instructed to actively oppose any present or future applications of this character."

THE Board of Directors of the Consumers Gas Company, of Newburgh, N. Y., have perfected the following executive organization: President, John C. Adams; Vice-President, Joseph H. Berry; Secretary and Treasurer, B. J. McDonald.

MR. C. H. CLARK, City Clerk of Great Falls, Montana, in asking for proposals for the public lighting of that place, says that proposals will be received "for 42 arc electric lights of 2,000-candle power each, or their equivalent in *acetylene* or gas lights." Evidently Great Falls has much desire to be considered up to date.

"OBSERVER," writing under date of the 9th inst., says: "I failed to find any mention in the JOURNAL of the result reached in the recent town election at Concord, Mass.. One of the matters voted upon was the question whether it would be expedient for the town to engage in the supply of gas and electric currents on municipal account; and the canvass showed a large majority in favor of the proposition."

THE proprietors of the Westfield (Mass.) Gas Light Company announce a reduction in the gross selling rate to $2 per 1,000, and in the net rate to $1.80 per 1,000.

MR. WILLIAM YORKE, the veteran Superintendent of the Portland (Me.) Gas Light Company, has not resigned his position; nor does the fact that the Company has designated an assistant to him signify that it proposes to retire him.

THE proprietors of the Jamaica Plain (Mass.) Gas Light Company have accepted the recommendation of the State Board of Gas and Electric Light Commissioners that, from the 1st inst., the net selling rate shall be $1.40 per 1,000 cubic feet, in consideration of prompt payment—within 15 days from presentation of accounts. Delinquents may be charged 20 cents per 1,000 over the net.

The Committee on Manufactures, of the lower branch of the Massachusetts Legislature, reported the following as fit measures for final legislation affecting the lighting interests of the State:

"A bill providing that the Supreme Judicial Court, or the Superior Court, or any justice thereof, in term time or during vacation, may, on application of the Board of Gas and Electric Light Commissioners, enforce by any approved process in equity, all lawful orders of said Board, in respect to persons, corporations or municipalities engaged in the manufacture of gas and electricity; also, that the State Inspector of Gas and Gas Meters shall hereafter make his annual report to the Board before the first Wednesday in January; also, a bill providing that the Chief of Police in any city or town, and the Medical Examiner in any district where any person, corporation or municipality is engaged in the gas or electric business, shall make written reports to the Board of Gas and Electric Light Commissioners concerning any and all accidents which shall occur from gas or electricity—the Chief of Police to report within 24 hours after the accident, and the Medical Examiner within 7 days; and a bill to require gas and electric light companies to keep uniform station records, in such form as the Board of Gas and Electric Light Commissioners may prescribe."

MR. VINTON W. MASON, the urbane Secretary and Treasurer of the Malden and Melrose (Mass.) Gas Light Company, has fortified himself. In other words, he was married, on the 7th inst., to Miss Gertrude Lord, of Jamaica Plain, Mass., the binding words having been spoken to the twain by the Rev. W. T. Chase, pastor of the Fifth avenue Baptist church, of Philadelphia. Mr. and Mrs. Mason will be at home to their friends, from to-day, in the Hotel Victoria, Malden.

MR. JOHN EDWARDS, a respected and long-time member of the Board of Directors of the Fredericton (N. B.) Gas Light Company, died at his home in Fredericton on the morning of the 6th inst. Deceased, who was in his 88th year, was born in Paisley, Scotland, June 1st, 1808, and, during his service with the Royal British Artillery, was ordered (1838) to St. Andrews, Nova Scotia, from where he was transferred to Halifax. Subsequently he was returned to St. Andrews, to take charge of the garrisoned fort at that point. In 1845 his regiment was stationed at Fredericton, which place was virtually his home from then until his death. Fredericton honored him with business, political and social preferment, in none of which responsibilities did he fail to conserve the trusts reposed in him. The funeral services were celebrated in St. Paul's Church, Fredericton, on the afternoon of the 8th inst., the Rev. Mr. Willard McDonald officiating. Interment was made in the Rural Cemetery.

MR. ROBT. B. TABER is in charge of the new construction work planned by the proprietors of the Chicopee (Mass.) Gas Company, which, we presume, has succeeded to the gas supply of Chicopee proper and the surrounding territory.

THE proprietors of the South Bend (Ind.) Gas Light Company deny in positive terms any intention on their part to sell or lease that property to anyone. They believe that the property is worth more to them than it possibly could be to anyone else.

THE handsome office building of the Indianapolis (Ind.) Gas Company, to be locally known as "The Mystic," will be ready for occupancy by June 1st.

A WISE Los Angeles (Cal.) Solon exists in the person of Judge Smith, who recently decided that Henry E. Seymour, who had been charged with purloining gas from the Los Angeles Lighting Company, was not guilty of theft, although he used gas without the intervention of a meter, and had his house pipes connected with the Company's supply, because it was proved that "he merely utilized the gas which escaped from a leak in the pipe."

MR. J. H. KIMBALL, who owned and operated the Kenosha (Wis.) Gas, Electric Light and Fuel Company for some years, has disposed of the property to Messrs. James Cavanagh (the leading lawyer of Kenosha, Wis.), E. N. Kimball and T. G. Littlehales. The purchasers held a meeting to reorganize the executive management of the Company, and the result of their deliberations was the election of the following officers: President, James Cavanagh; Secretary and Treasurer, E. N. Kimball; Vice-President and Manager, T. G. Littlehales. Mr. Littlehales is a nephew of the Manager of the Syracuse (N. Y.) Gas Company. The Company intends to make a vigorous canvass for consumers on cooking account, and also proposes to have a try at the public lighting, using Welsbach lamps therefor. We append some extracts from a circular just issued by the Company:

"The first cost of making fuel gas connections in the past (averaging from $8 to $12) has undoubtedly kept many people from using gas for fuel purposes. With a view to removing this objection, the Gas Company has decided to offer the following inducements for the season of 1896. On or about April 15th the Company will open an office and showroom at No. 267 Main street, in the store at present occupied by A. R. Chamberlin, and will offer to the public a full line of gas cooking ranges, heating stoves, gas grates and other gas appliances. In order to induce a general use of gas for cooking and heating purposes the Company makes the following liberal offer, viz.: From April 15 to Nov. 1, 1896, all gas ranges (a range is understood to be a gas stove with permanent baking and broiling ovens, and not less than 3 top burners) will be sold by said Company at a discount of 25 per cent. from regular list prices, and placed in consumer's residence ready for use free of charge. In this way the price paid for the stove will constitute the sole expense to consumer. Remember, this offer only holds good from April 15 to Nov. 1, 1896, and is made to induce the people to understand that the gas stove, as well as being a luxury for the rich, is also the poor man's friend. The true value of gas as a fuel for domestic purposes is known and appreciated alone by those who have used it and cannot be well overestimated. The work of introducing gas cooking ranges to the public is one of much effort, owing to the popular fallacy that its use is accompanied by great expense, and that the viands so cooked are tainted by gas. These delusions are quickly dispelled. As a matter of absolute fact, the price at which gas is now sold for fuel ($1 per 1,000 cubic feet) clearly demonstrates that it costs actually less than coal. Gas for cooking recommends itself because it is convenient, clean and economical. There is no dust, no soot, no ashes, no smoke, no coal to carry, no waste heat and absolutely no danger. A breakfast, including hot biscuits, or one such as is served daily in ordinary households, can be placed upon the table in 20 minutes after lighting the range. It is a fact worthy of consideration that meat roasted by coal fire loses in weight fully one-third, while the shrinkage by cooking with gas is only one-seventh. Many families in Kenosha are using gas stoves exclusively for cooking all the year round, finding them cheaper than coal stoves. Ask some of your friends about them. Applications for service pipes, fuel pipes, meter connections, etc., should be made at the Company's office. In order to insure prompt attention all business pertaining to the Company should be referred to the Manager, either by mail or in person.—T. G. LITTLEHALES, Manager."

THE Berlin Iron Bridge Company, of East Berlin, Conn., has been awarded the contract to furnish the steel work for the new boiler plant of the New Britain Knitting Company. The roofs of the buildings

will be supported by steel trusses throughout, and the designing of the structures was made with a view to having them thoroughly fireproof.

MR. WM. NEWELL, who had served many terms as President of the Pawtucket (R. I.) Gas Company, died at his home in Central Falls, R. I., on the afternoon of April 13. He was in his 76th year.

ACCORDING to the annual report of Mr. W. H. Knowles, Supt. of the Richmond (Va.) City Gas Works, which covers the operations of the system for the year ended December 31, 1895, it is seen that the total receipts were $161,882.73 and the disbursements were $144,343.84, showing a profit of $17,538.89. Gas to the amount of 24,045,200 cubic feet was furnished on city use account free of charge. The coal carbonized in retorts amounted to 11,199,967 pounds, and the coke used under the retorts amounted to 79,217 bushels; lime for purifying purposes, 8,980 bushels; coal used at engine station, 656,230 pounds; oil used in water gas plant, 825,430 gals.; coke used in water gas plant, 6,049,173 pounds; steam coal used in water gas plant, 1,270,499 pounds; coke made and purchased, 9,175,750 pounds. The total quantity of gas made was 208,520,700 cubic feet, of which 25 per cent. was coal gas and 75 per cent. was water gas. The increase in sendout during 1895 compared with 1894 was 9,155,900 cubic feet. The maximum sendout for any 24 hours was on December 19, when 921,151 cubic feet of gas were distributed. During the year 4,951 feet of street mains were laid, bringing the total mileage up to 71 miles, 1,292 feet. Services to the number of 236 were put in during the year. Referring to the physical condition of the plant, Supt. Knowles says: "When I took charge of these works, in June last, I found them in very bad condition, and it was absolutely necessary to make the following repairs and improvements:

"1. Coal Plant.—Three new benches of 6's; 3 new buckstays on block of 6's; iron blinds to retort houses repaired and painted, and stone slabs taken up and replaced with granite blocks.

"2. Water Plant.—New engine and blower, new oil heater, oil pump, pressure tubes, conduit and blast pipes, relining generators and superheaters, new down-run valves and oil injectors, small engine and shafting remodelled and new stack to superheater.

"3. General Repairs."—Here are specified certain minor, but very general repairs to purifiers, steam service, storage capacity, sheds, roofs, etc.

"4. Upper Works.—The large gasholder, located on the site of the upper works, on Dock street, was so much out of repair that it was necessary to discontinue its use until it could be fixed. The repairs consisted of inner sheet hydraulic cup, lining up buckstays, counterbalance weights, guide rollers, and chains for same, etc. From the best information I could obtain (which is from the employees who worked this holder), the city lost about 3,000,000 cubic feet of gas by leakage before this holder was repaired. The repairing was done by the Tredegar Iron Company, and is first-class in every particular.

"These extraordinary expenses prevented a more favorable showing of the result of the year's work. The amount of gas consumed in 1895 fully demonstrates the necessity of putting the coal plant in perfect condition, and prompt action in this matter should be taken with the view of placing the works in proper condition to meet the rapidly increasing demand. Should the present year be a prosperous one, I have no doubt that the works will be taxed next winter to their utmost capacity to supply the demand.

"I am now extending the 20-inch main from Belvedere and Broad streets, up Broad to Lombardy, and running two 10-inch lateral mains, connecting with all of the parallel streets as far south as Cary street, and when this work is completed it will give, I think, the consumers in this district the necessary supply for some years to come.

"I most respectfully recommend the necessity of erecting a new storage holder, of 1,000,000 cubic feet capacity, in the West End of the city, because of the uncertain condition of the one now in use at the upper works; also, because of the financial advantage that would be derived thereby. With additional holder capacity the plant could be run to advantage, with a large saving of labor and fuel, and the distribution of gas would be more thorough, with a great saving to the consumer.

"I am gratified to be able to state that the officers and employees have been faithful in the discharge of their respective duties, and have always manifested a willingness to assist me in carrying out any measure which I might suggest for the benefit of the works."

As the new sanitary regulations of the city of Savannah, Ga., go into effect on May 1st, the Mutual Gas Light Company has notified the residents that those desirous of putting in gas services must have the work done before the date named. After May 1st the city ordinances forbid the digging up of the streets until November 1st. The Mutual Company makes no charge for putting in gas connections.

MESSRS. H. P. CUMMINGS & CO. have been awarded the contract for the construction of the new purifying house for the Malden and Melrose (Mass.) Gas Light Company. The structure will be of brick with iron floors, and its dimensions are 165 feet long by 38 feet wide.

RECENT press despatches are to the effect that seven suits, the aggregate damages being placed at $40,000, have been entered in the Superior Court against the Greenfield Gas Light Company, by members of the family of Lafayette Mogle, of Greenfield, Mass. Plaintiffs charge that, owing to the negligence of the Company, gas has been allowed to escape from defective mains into their house in Olive street, and that the inhalation thereof has caused sickness and death in their family.

Encouraging Petroleum Refining in Germany.

According to H. Urban, the German Government is moving in the matter of attempting to compete with the foreign petroleum suppliers. The first sessions of a committee, appointed to inquire into this matter, were held the latter part of February in the Ministry of the Interior, at Berlin. These sessions, however, were only of informal character, and besides the commissioners of the different departments, none but experts took part in the deliberations. The chairman of the committee, Dr. Rothe, announced that representatives of commerce and industry would be invited to appear before the committee. The subject will be considered thoroughly and all parties interested will have ample time and occasion to express their opinion. The purpose of this inquiry is to promote the establishment of a German refining industry by means of suitable tariff regulations. Austria will gladly welcome a new condition of things in Germany. The Galician producers will find a valuable market for their crude product in Germany. Russia will hardly play an important part in supplying the German refineries, as an oil burdened by 65 per cent. of residue could not very well be imported with profit. Thus America would again be the principal source of supply, but in regard to crude oil it is not the Standard Oil Company alone, for the independent producers will compete strongly with this company. Enough German capital will be found to establish refineries and very little fear is entertained that they would be swallowed up by American refineries which should probably be erected in Germany. The German oil fields are not so insignificant as is often believed, and the production may be greatly increased by rational methods. Galicia will develop enormously if the German market should be opened to its crude product. Roumania, too, has some chances; yet its participation in supplying Germany will depend upon the prices of the crude oil. It certainly will be obliged to look for new markets, as its export to Austria-Hungary is limited to a certain quantity by treaty.

The Coal Fields of China.

There are symptoms indicating that the Chinese near Pekin are awakening to the advantage of employing foreign engineering knowledge and machinery, says a correspondent in the Pekin and Tientsin *Times*. Considerable coal fields extend over a vast area of the mountains north and west of the capital, at a distance of about 100 li from it. They have hitherto been worked by the stereotyped, irrational, mole fashion, so characteristic of Chinese. When the natives discovered the coal seams on the sides of the mountains, they commenced digging into them, and in some places they have penetrated as far as 8,000 feet, in others only a few hundred feet, when they were stopped by water, with which difficulty they have been entirely unable to cope, and the mines have consequently, in many cases, been abandoned. We are glad, however, to hear that some rich Chinese, stirred by the railway movement, have entered into contracts with a foreign engineer to develop the mining possibilities of the northern district.

China's coal fields are exceeded only by those in America, and in a more distant time they will have equal effect on the commerce and manufactures of the world. The cost of sea freights has been low enough to allow the coal to be carried to distant countries and sold more cheaply than coal from nearer sources; but the construction of railways, the improvement of navigable rivers and other means of transport are, in many countries, entirely altering the conditions of the coal trade, and in Japan, India and Australia the native coal is rapidly superseding the imported coal, and the same change will eventually take place in South Africa and in China when the coal deposits are developed.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

EDITOR—Jos. R. Thomas, C.E.
ASST. EDITOR—T. J. Cunningham.
MANAGER—C. E. Sanderson.

PUBLISHED ON EACH MONDAY OF THE YEAR AT
No. 32 Pine Street, New York.

This is a recognized official organ of
LIGHT, HEAT, STEAM, WATER SUPPLY,
VENTILATION, SANITARY IMPROVEMENT,
AND GENERAL SCIENCE.

TERMS:

SUBSCRIPTION—Three Dollars per annum, in advance. Single copies, 10 Cents.

AGENTS:

New York—American News Co., 39 and 41 Chambers St.
Germany—B. Westermann & Co., of New York.
England—Aug. Siegle, 30 Lime Street, London.

MONDAY, APRIL 20, 1896.

The Market for Gas Securities.

The market for city gas shares was quite animated during the week, several important transactions having been completed, at notable advances in values. Consolidated sold up to 157½, and this morning (Friday) the opening was made at 157 to 157¼. The situation at Albany is unchanged, and the law makers have agreed to suspend further operations for the year on April 30. That is, they will adjourn on that date. Even at 157, Consolidated looks a decided purchase. Mutual developed great strength, the round figure of 235 being freely bid for it. Equitable also boomed up to 215 bid, and holders were seemingly disinclined to part with the shares at anything under 218. New York and East River common advanced to 36½ bid, but Standard common did not more than hold its own. Standard preferred, however, was a bit stiffer, at 106½ to 108½. In our opinion none of the shares above mentioned are at their real value under the figures quoted, for we imagine that this summer and fall will witness notable advances in the matter of bringing all the gas interests of the city into closer relations. The Brooklyn Union Company's shares are very strong, at 88 to 88½, and there is little doubt that a dividend on the same will shortly be declared. Chicago gas, after selling up to 70⅞, ran off to 68½, at which figure it was at noon to-day. The stock is cheap at anything under 75. Baltimore Consolidated is 64⅛ to 64½, with every likelihood that it will sell at 70 before the summer is over. Consumers, of Jersey City, is slowly moving upward, at 83½ bid. Lacledes are dull and uncertain. Western gas, of Milwaukee, is steady, at 64 to 66, and the collateral trust 5's are in good demand, at 87 to 89.

Gas Stocks.

Quotations by Cochran & Close, Brokers and Dealers in Gas Stocks.

35 WALL ST., NEW YORK CITY.

APRIL 20.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$35,430,000	100	157	157¼
Central	500,000	50	150	..
" Scrip	230,000	..	100	.
Equitable	4,000,000	100	215	..
Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,800,000	1,000	114	.
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	235	..
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	.
Northern	150,000	50	79	80½
" Bonds	150,000	1,000	..	98
New York and East River	5,000,000	100	36⅛	38½
Preferred	2,000,000	100	72	75
Bonds 1st 5's	3,500,000	1,000	100¼	101¼
" 1st Con. 5's	1,500,000	..	88½	89¾
Richmond Co., S. I.	348,650	50	50	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	75	78
Preferred	5,000,000	100	106½	108½
Bonds, 1st Mortgage, 5's	1,500,000	1,000	108⅛	110½
Yonkers	299,650	50	130	.
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	88	88½
" " Bonds (5's)	15,000,000	1,000	105¼	106
Bay State	5,000,000	50	23¾	23¼
" Income Bonds	2,000,000	1,000	..	90
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	78	80
2d " " "	3,000,000	1,000	53½	55½
Buffalo Mutual	750,000	100	125	..
" Bonds	200,000	1,000	95	100
Central, San Francisco	2,000,000	..	95	..
Chicago Gas Co.	25,000,000	100	69¼	69⅝
Chicago Gas Lt. & Coke Co. Guaranteed Gold Bonds	7,650,000	1,000	94	94½
Columbus	1,069,000	..	..	65
1st Mortgage	1,085,000	..	..	96
Consumers, Jersey City	2,000,000	100	83½	..
" Bonds	600,000	1,000	103	..
Cincinnati G. & C. Co.	7,000,000	100	204	304½
Consumers, Toronto	1,800,000	50	184½	187
Capital, Sacramento	500,000	50	..	41
Bonds (6's)	150,000	..	.	.
Consolidated, Baltimore	1,000,000	100	64⅛	64⅝
Mortgage, 6's	3,800,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,400,000	..	..	..
Detroit	4,000,000	..	..	29
" Con. Bonds	4,312,000	..	76	77
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	91	94
" Bonds	2,000,000	..	92	95
Hartford	750,000	25	..	145
Indianapolis	2,000,000	..	137	141
" Bonds, 6's	2,650,000	..	107	108
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind.	1,000,000	100	94	..
Bonds	1,000,000	1,000	97	99
Louisville	2,570,000	50	..	130
Laclede, St. Louis	7,500,000	100	27	..
Preferred	2,500,000	100	84	86
Bonds	9,084,400	1,000	94½	94¾
Little Falls, N. Y.	50,000	100	..	100
Bonds	25,000	..	..	100
Montreal, Canada	2,000,000	100	200	.
Newark, N. J., Gas Co.	1,000,000	..	98	98
Bonds, 6's	4,000,000	.	123	..
New Haven	1,000,000	25	225	..
Oakland, Cal.	2,000,000	..	46½	..
" Bonds	750,000	..	..	..
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	2,100,000	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	..	175
Paterson, N. J.	.....	25	99	102
Rochester Gas & Elec. Co.	2,150,000	50	..	..
Preferred	2,150,000	50	88	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	84½	85
St. Paul Gas Light Co.	1,500,000	100	67½	70
1st Mortgage, 6's	650,000	..	84	87
Extension, 6's	600,000	..	.	..
General Mortgage, 5's	2,400,000	.	88	90
Syracuse, N. Y.	500,000	25	..	..
Washington, D. C.	2,000,000	20	250	..
Western, Milwaukee	4,000,000	100	63	65
Bonds, 5's	3,556,000	.	87	89
Wilmington, Del.	500,000	5	188	190

Advertisers' Index.

GAS ENGINEERS.

	Page
Jos. R. Thomas, New York City	641
Wm. Henry White, New York City	639
Fred. Bredel, Milwaukee, Wis.	635
H. C. Slaney, Brooklyn, N. Y.	639
Geo. R. Rowland, New York City	639
The Western Gas Construction Co., Fort Wayne, Ind.	630
Humphreys & Glasgow, New York City	626
T. G. Lansden, St. Louis, Mo.	639
American Gas Co., Phila., Pa.	623
David Leavitt Hough, New York City	620

CHEMISTS.

Herman Poole, New York City	621

PROCESSES.

Bartlett, Hayward & Co., Baltimore, Md.	637
United Gas Improvement Co., Phila., Pa.	629
Burdett Loomis, Hartford, Conn.	638
National Gas and Water Co., Chicago, Ills.	631
Economical Gas Apparatus Construct'n Co., Toronto, Ont.	637
The Western Gas Construction Co., Fort Wayne, Ind.	630
A. M. Sutherland, New York City	624

GAS WORKS APPARATUS AND CONSTRUCTION.

James R. Floyd & Sons, New York City	640
Continental Iron Works, Brooklyn, N. Y.	638
Deily & Fowler, Phila., Pa.	640
Kerr Murray Mfg. Co., Fort Wayne, Ind.	636
Stacey Mfg. Co., Cincinnati, Ohio	639
Bartlett, Hayward & Co., Baltimore, Md.	637
Davis and Farnum Mfg. Co., Waltham, Mass.	636
R. D. Wood & Co., Phila., Pa.	638
Isbell-Porter Company, New York City	638
Fred. Bredel, Milwaukee, Wis.	635
United Gas Improvement Co., Phila., Pa.	629
Berlin Iron Bridge Co., East Berlin, Conn.	626
National Gas and Water Co., Chicago, Ills.	631
Economical Gas Apparatus Construct'n Co., Toronto, Ont.	637
The Western Gas Construction Co., Fort Wayne, Ind.	630
Humphreys & Glasgow, New York City	626
Gas Engineering Co., Pittsburgh, Pa.	636
American Gas Co., Phila., Pa.	623

SCRUBBERS AND CONDENSERS.

G. Shepard Page's Sons, New York City	639
R. D. Wood & Co., Phila., Pa.	638
James R. Floyd & Sons, New York City	640
Continental Iron Works, Brooklyn, N. Y.	638
Gas Engineering Co., Pittsburgh, Pa.	636

REGENERATIVE FURNACES.

Bartlett, Hayward & Co., Baltimore, Md.	637
Fred. Bredel, Milwaukee, Wis.	635
J. H. Gautier & Co., Jersey City, N. J.	635
Parker-Russell Mining and Mfg. Co., St. Louis, Mo.	634
Adam Weber, New York City	634

TAR AND CARBONIC ACID EXTRACTOR.

G. Shepard Page's Sons, New York City	639

AMMONIA CONCENTRATORS.

Michigan Ammonia Works, Detroit, Mich.	630
G. Shepard Page's Sons, New York City	639
Gas Engineering Co., Pittsburgh, Pa.	636

GAS METERS.

John J. Griffin & Co., Phila., Pa.	644
American Meter Co., New York and Philadelphia	643
The Goodwin Meter Co., Phila., Pa.	642
Helme & McIlhenny, Phila., Pa.	643
D. McDonald & Co., Albany, N. Y.	643
Nathaniel Tufts, Boston, Mass.	642
Maryland Meter and Mfg. Co. Baltimore, Md.	642
Metric Metal Co., Erie, Pa.	641
Keystone Meter Co., Royersford, Pa.	642
The Hillen Meter Co., Brooklyn, N. Y.	643

PREPAYMENT METERS.

American Meter Co., New York and Philadelphia	643
John J. Griffin & Co., Phila., Pa.	644
D. McDonald & Co., Albany, N. Y.	643

GAS AND WATER PIPES.

Ohio Pipe Co., Columbus, Ohio	641
M. J. Drummond, New York City	641
R. D. Wood & Co., Phila., Pa.	638
Warren Foundry and Machine Co., New York City	641
Donaldson Iron Co., Emaus, Pa.	641
Addyston Pipe and Steel Co., Cincinnati, O.	641

PIPE CUTTERS.

Wm. Anderson, East Boston, Mass. 621

GAS BAGS.

Peerless Rubber Mfg. Co., New York City 621

STEAM BLOWER FOR BURNING BREEZE.

H. E. Parson, New York City 635

GAS COALS.

Penn Gas Coal Co., Phila., Pa. 633
Perkins & Co., New York City 632
Despard Gas Coal Co., Baltimore, Md. 623
Westmoreland Coal Co., Phila., Pa. 623
Berwind-White Coal Mining Co., New York and Phila. ... 632
Henry C. Scheel, New York City 633

CANNEL COALS.

Perkins & Co., New York City 622
Henry C. Scheel, New York City 623

GAS ENRICHERS.

Standard Oil Co., New York City 638
The Sun Oil Co., Pittsburgh, Pa. 633
W. H. Townsend, New York City 633

COKE CRUSHER.

C. M. Keller, Columbus, Ind. 633

CONVEYING MACHINERY.

C. W. Hunt Company, N. Y. City 621

GAS GAUGES.

The Bristol Co., Waterbury, Conn. 621

GAS GOVERNORS.

Connelly Iron Sponge and Governor Co., New York City. 631
Isbell-Porter Co., New York City 638
The Wilder Mfg. Co., Phila., Pa. 621

SELF-SEALING MOUTHPIECE DOORS.

Isbell-Porter Company, New York City 638
Continental Iron Works, Brooklyn, N. Y. 638
G. Shepard Page's Sons, New York City 639

RETORTS AND FIREBRICK.

J. H. Gautier & Co., Jersey City, N. J. 634
B. Kreischer & Sons, New York City 634
Adam Weber, New York City 634
Laclede Firebrick Mfg. Co., St. Louis, Mo. 634
Cyrus Borgner, Phila., Pa 634
James Gardner, Jr., Pittsburgh, Pa. 634
Henry Maurer & Son, New York City 634
Baltimore Retort and Firebrick Co., Baltimore, Md. 634
Parker-Russell Mining and Mfg. Co., St. Louis, Mo. 634
Brooklyn Firebrick Works, Brooklyn, N. Y. 634

CEMENTS.

C. L. Gerould & Co., Mount Vernon, N. Y. 634

INCANDESCENT GAS LAMPS.

Welsbach Commercial Co., Phila., Pa. 623

MICA GOODS.

The Mica Mfg. Co., New York City 620

BURNERS.

C. A. Gefrorer, Phila., Pa. 638

LAVA GAS TIPS.

D. M. Steward Mfg. Co., Chattanooga, Tenn. 621

GAS TUBING.

Wm. M. Crane & Co., New York City 624

PURIFYING MATERIALS.

Connelly Iron Sponge and Governor Co., New York City 631
Greenpoint Chemical Works, Brooklyn, N. Y. 631
Henry W. Douglas, Ann Arbor, Mich. 631

EXHAUSTERS.

The P. H. & F. M. Roots Co., Connersville, Ind 628
Isbell-Porter Company, New York City 628
Connelly Iron Sponge and Governor Co., New York City 631

VALVES.

Ludlow Valve Manufacturing Co., Troy, N. Y. 630
Chapman Valve Manufacturing Co., Boston, Mass. 630
R. D. Wood & Co., Phila., Pa. 638
Continental Iron Works, Brooklyn, N. Y. 633
The P. H. & F. M. Roots Co., Connersville, Ind. 628
Isbell-Porter Co., New York City 638
The Western Gas Construction Co., Fort Wayne, Ind. ... 630

ELECTRICAL APPARATUS.

Wm. Henry White, New York City 639

GAS ENGINES.

Otto Gas Engine Works, Phila., Pa. 604
The American Gas Engine Co., Phila., Pa. 622
Backus Water Motor Co., Newark, N. J. 580

ENGINES AND BOILERS.

The Hazelton Boiler Company, New York City 621
W. G. & G. Greenfield, East Newark, N. J. 621

PURIFIER SCREENS.

John Cabot, New York City 635

GAS STOVES.

American Meter Co., New York and Philadelphia 637
The Goodwin Meter Co., Phila., Pa. 642
George M. Clark & Co., Chicago, Ills. 625
Maryland Meter and Manufacturing Co., Baltimore, Md. 642
William M. Crane & Co., New York City 624
Keystone Meter Co., Royersford, Pa. 642
A. Weiskittel & Son, Baltimore, Md. 635

CHINA GAS KILNS.

William M. Crane & Co., New York City 624

GASHOLDER PAINT.

New York Marine Paint Co., Poughkeepsie, N. Y. 630

RED CEDAR TANKS.

Williams Mfg. Co., Kalamazoo, Mich. 630

GASHOLDER TANKS.

J. P. Whittier, Brooklyn, N. Y. 630

GASHOLDERS.

Bartlett, Hayward & Co., Baltimore, Md. 637
Continental Iron Works, Brooklyn, N. Y. 638
Deily & Fowler, Philadelphia, Pa. 640
Davis & Farnum Mfg. Co., Waltham, Mass. 636
Kerr Murray Mfg. Co., Fort Wayne, Ind. 636
Stacey Mfg. Co., Cincinnati, Ohio. 639
R. D. Wood & Co., Philadelphia, Pa. 638

WANTED,

By a young man of 20 years' experience, a position to take full charge of a medium or small Gas Works, especially where works and business need building up. Coal gas works preferred. A worker and systematic as well as economical manager in all details of the business—manufacturing, construction, mechanical and clerical. Has been successful in pushing the gas stove business for several years. Can furnish competent and unquestionable references. Address

1089-4 "C. A. T.," care this Journal.

POSITION WANTED

By a thoroughly practical man, with 14 years' experience as Manager of works of about 30 millions. Understands mechanical drawing and construction. Address

1089-3 "H. N.," care this Journal.

Situation Wanted

As Superintendent of Gas Works,

by a young man of 10 years' experience. Competent in all of the departments, including office work. Has had experience in the building of water works and the operation of electric plants. Can furnish best of references. Has been Superintendent of a Gas Works for the past 10 years.

1088-2 Address "R. K.," care this Journal.

Position Wanted

As Superintendent of Gas Works.

Has been in the employ of the Passaic (N. J.) Gas Company for the last 10 years as Superintendent, and is a practical mechanic, thoroughly understanding the laying out and erection of plants and the making of coal and water gas. Seventeen years' experience as constructor and builder with John Hanlon, Gas Engineer. Best of references. Address

1086-5 FRANK JONES, Passaic, N. J.

Are You Going to the Chattanooga meeting of the Western Gas Association? If so, you will meet a number of progressive Engineers of Coal Gas Works who are alive to the merits of **BEAR CREEK CANNEL COAL.** Find out about it!

1089-4 MACFARLANE & CO., Louisville, Ky.

WANTED,

A Second-Hand Wood's Condenser,

Capacity, 50,000 to 75,000 feet per day. Also,

Station Meter, 5 x 5.

State price and condition. Address "A. H.,"

1088-6 Care this Journal.

WANTED,

Two Cast Iron Purifying Boxes,

6 ft. by 8 ft., 3 ft. deep, 18 inch Seal, 8 inch Connections.

Address J. O. HUDSON,
Supt. Gas Light Co.,

1087-3 Bordentown, N. J.

FOR SALE,

Four Purifying Boxes, 8 ft. by 8 ft.,

with 6-inch Center Valves and Connections, in good order.

HOUSTON GAS LIGHT CO.,

1085-10 Houston, Texas.

FRED. H. WILKES,

Accountant and Auditor,

KINGSTON, N. Y. (P.O. Box 1095.)

Gas Companies', Electric Lighting and Street Railway Accounts Audited and Systematized. Special Consumers' Ledgers. Books and forms made up for any requirements. State Reports attended to. 1086-4

DAVID LEAVITT HOUGH,

26 CORTLANDT ST., N.Y. CITY.

Consulting Engineer.

Investigations and Appraisals.
Designs and Estimates.

Contractor.

Machinery and Structures.
Gas and Water Pipe.

Special Agent for Selling & Purchasing.

MICA CHIMNEYS

MICA CANOPIES AND CHIMNEYS

For Welsbach Lights.

Send for Catalog and Discounts.

The Mica Mfg. Co.,

MICASMITHS,

No. 88 Fulton St., N. Y. City.

Utilize Your Gas Liquor.

NO EXTRA LABOR OR OPERATING EXPENSES.

Ammonia Concentrator,

Not Expensive. Write to

STROH & OSIUS, Pat'ees, or
Mich. Ammonia Works, Detroit, Mich.

THE GREATEST IMPROVEMENT IN GAS LIGHTING
Has been made by
WILDER'S VOLUMETRIC GOVERNORS.

They control the pressure at the burner, and deliver the quantity for which they are set regardless of high or low pressure in the supply.

WELSBACH LIGHTS are fully controlled, and the governors soon pay for themselves by preventing the breaking of mantles and chimneys. Thousands are already in use. Orders may be given to the Welsbach Co., or sent to ourselves.

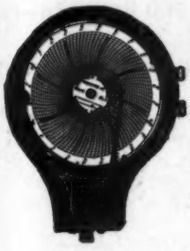
THE WILDER MANFG. CO., - 816-822 Cherry St., PHILADELPHIA.

Patent Lava Gas Tips.

UNIFORMITY GUARANTEED.
ALL SIZES AND SHAPES.

D. M. STEWARD MFG. CO.,
CHATTANOOGA, TENN.

BRISTOL'S RECORDING **PRESSURE GAUGE**



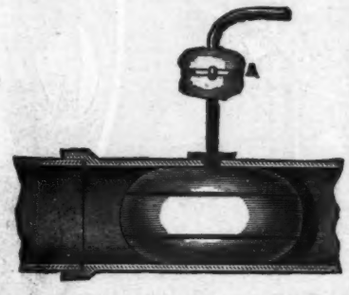
For Continuous Records of
Street Gas Pressure.

Simple in Construction,
Accurate in Operation,
Low in Price,
Fully Guaranteed.
Send for Circulars.

THE BRISTOL CO.
Waterbury, Conn.

Received Medal at World's Columbian Exposition.

Peerless Patent Improved Gas Bag



These Gas Bags are used to stop the flow of gas while repairing or making alterations in gas mains. There have been numerous cases of workmen being badly injured, and sometimes fatally, by the escape of gas resulting from the bursting of a bag, and our patent improvement is designed to obviate such calamities. The indicator *A* shows unerringly when the bag has been sufficienty inflated to pack the main, and when the pumping should be stopped. Our Bags are made of a rubber stock especially prepared to admit of great distension, and to resist the action of Oils, Gases, Naphtha and other residuum in the mains, and they are made with lapped joints, which adds greatly to their strength.

3-in. Gas Bag, each,			$0.60	12-in. Gas Bag, each,			$5.00
4 "	"	"	.80	16 "	"	"	8.25
5 "	"	"	1.05	20 "	"	"	12.00
6 "	"	"	1.75	24 "	"	"	17.00
8 "	"	"	2.65	30 "	"	"	27.50
10 "	"	"	3.75				

The Peerless Rubber Mfg. Co.
16 Warren St., N. Y. City.

HERMAN POOLE * Chemical Engineer,
323 West 34th Street, N. Y. City,
Makes a Specialty of
PURIFICATION
And the Utilization of Waste Products in Gas Manufacture.

C. W. HUNT COMPANY.

THE HUNT TIP CAR.

COKE CARS for Gas Works,
TIP CARS for Carrying Ashes,
CHARGING CARS for Bringing Coal from the Storage Bins to Boiler Room and Retort Houses.

INDUSTRIAL RAILWAYS
Specially designed for handling material in and around
Gas Works, Coal Yards, Factories, Etc., Etc.

45 BROADWAY, - - NEW YORK.

THE ANDERSON Patent Cutter Carrying Link
Made in all sizes.

Will cut from 2 in. to 24 in.
Pipe Cutting Tool

For Cutting Cast, Wrought Iron, Gas & Water Pipes.
WM. ANDERSON,
425 Meridian Street,
East Boston, Mass., or
WALDO BROS.,
88 Water Street, Boston, Mass.

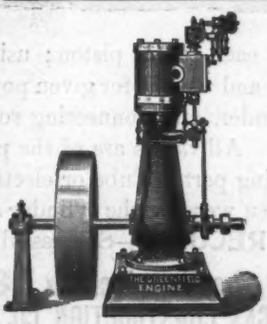
The Pioneer Vertical Water-Tube Boiler of the World!

THE HAZELTON OR PORCUPINE BOILER.

After Sixteen Years of Active Service in all the Principal Industries, this Boiler has Proven Itself Superior to all Others in Economy of Fuel, Durability, Safety and General Efficiency.
NO EXPLOSIONS OR ACCIDENTS OF ANY KIND.

Correspondence Solicited.

The HAZELTON BOILER COMPANY,
Sole Proprietors and Manufacturers,
Cable Address, "Palla," New York.
Tele., "1229-18th St.," New York.
Gen'l Office, 716 E. 13th St., N.Y., U.S.A.



GREENFIELD
Steam Engine Works.
Established 1874.
MANUFACTURERS OF
Greenfield Stationary, Portable and Yacht
ENGINES AND BOILERS.
Also Horizontal, Automatic and Variable Cut-off Engines.
Sizes from 3 to 75 Horse Power.
Also Vertical and Horizontal and Marine Boilers.
Steam Pumps and Adams' Crate Bars.
W. G. & G. GREENFIELD, - · EAST NEWARK, N. J.

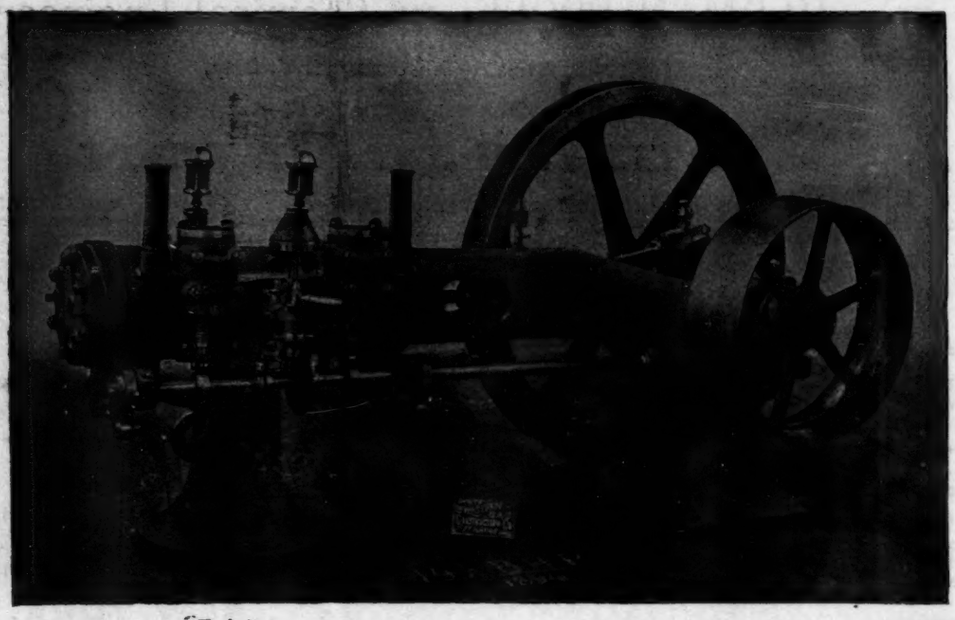
WM. W. GOODWIN, Prest. O. N. GULDLIN, V.-Prest. & Treas. H. B. GOODWIN, Sec. ERNEST F. LLOYD, Asst. Sec

THE AMERICAN GAS ENGINE CO.,

MANUFACTURERS OF

The Double-Acting Gas Engine,

Under the Patents of Griffin, and Dick, Kerr & Co., of London and Kilmarnock.



**

Single Cylinder.

Impulse Every Revolution.

(Two Strokes.)

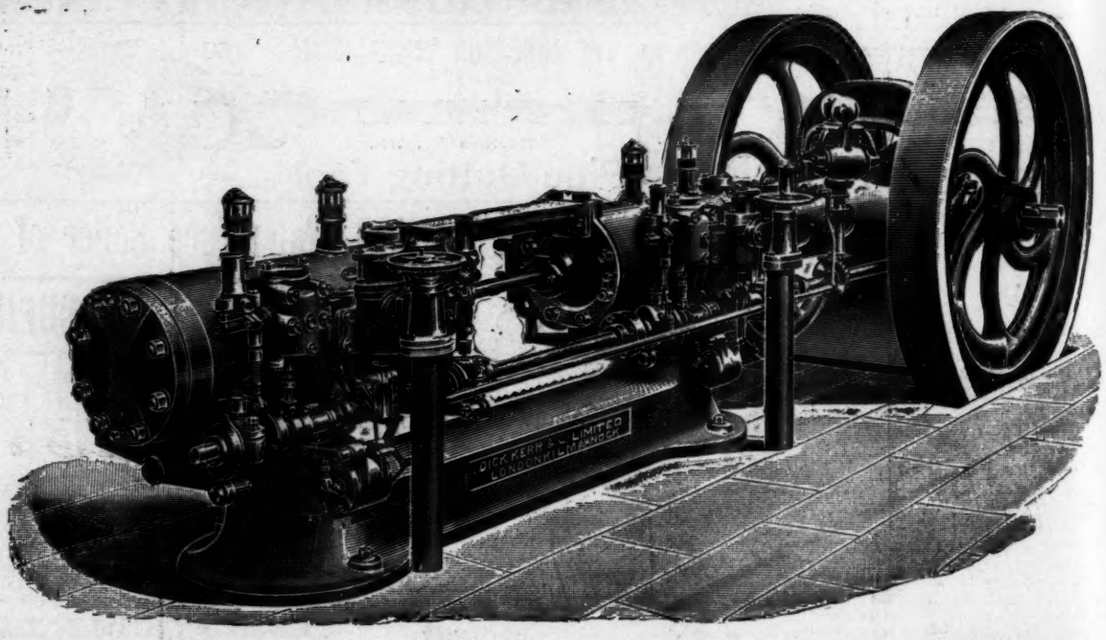
15 to 500 Horse Power.

For General Work and Isolated Electric Plants.

**

Tandem Cylinder. Impulse Every Stroke. 100 to 1,000 Horse Power.

For Central Stations and all work requiring extreme steadiness.



ESSENTIAL PRINCIPLE.—An impulse at each end of piston; using half force to each impulse; doubling the steadiness; reducing the wear on moving parts, and weight for given power. **CONSTRUCTION.**—The piston rod works through stuffing box in front end of cylinder, and connecting rod is carried in a cross-head working in a slide in frame, as in ordinary steam engine practice. All valves are of the poppet type, operated by cams on a single cam-shaft, giving positive movement to every working part. Tube or electric ignition. **RESULT.**—An engine of extreme simplicity and steadiness of action, the even wear on the cylinder and all working parts assuring increased economy, long life, and minimum cost in repairs. **RECORD.**—Successful and constant use in Great Britain for the past eight years. Address

W. W. GOODWIN, President, Lock Box 718, Philadelphia, Pa., or
THE WESTERN GAS CONSTRUCTION CO. Bldrs. & Gen. Agts. Fort Wayne Ind.

The Improved

Welsbach Light.

No. 34 Burner, with No. 74 Shade.

No. 34 Burner, with Nos. 10 and 43 Shades.

Welsbach Commercial Company,

Drexel Building,

PHILADELPHIA, PA.

AMERICAN GAS COMPANY,

222 South Third Street, Philadelphia, Pa.

Owns, Operates, Buys and Leases Gas Works.

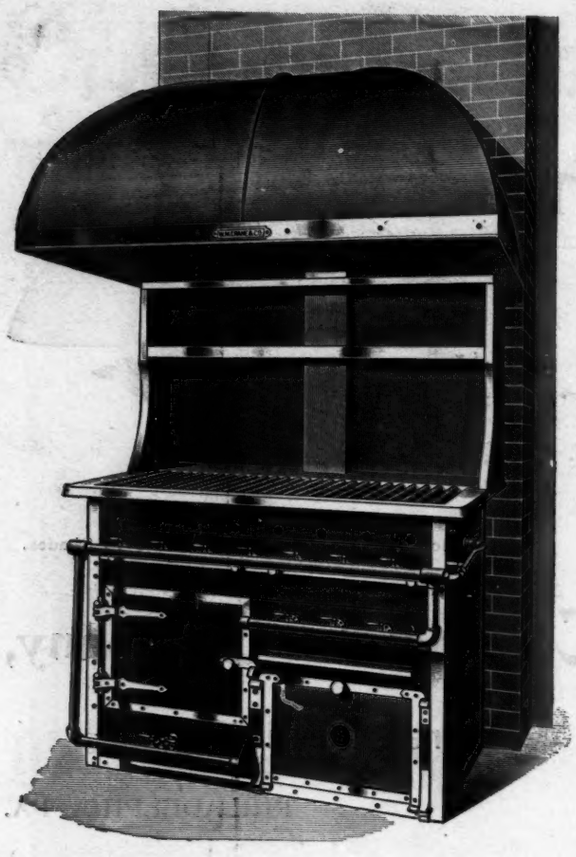
ALSO UNDERTAKES ALL KINDS OF CONSTRUCTION WORK.

Especially the Installation or Extension of Plants for the Manufacture of Gas from Caking Coal.

The attention of Gas Managers is particularly called to the many improvements in this method of manufacture instituted during the past fifteen years, and the extremely low cost at present of Coal Gas.

CORRESPONDENCE RESPECTFULLY SOLICITED. Address

GEO. G. RAMSDELL, Gen'l Mangr.



We Make Everything in the Line of Gas Appliances.

THE VULCAN STEEL RANGE,

For Hotels and Large Families,

is the finest in the world. Write for special information.

Special attention has been given to hotel wants, and a number of Hotels, Restaurants, Banks and Insurance Companies have been fitted up with complete kitchen outfits. We were awarded a Gold Medal and Diploma for the Creole Kitchen at the Atlanta Exposition in 1895.

W. M. CRANE & CO.,

MANUFACTURERS OF GAS APPLIANCES,

OFFICE:

No. 838 Broadway, New York City.

Factory:

447 to 453 W. 14th Street.

THE LITTLE GIANT (SUTHERLAND'S IMPROVED LOWE) GENERATOR.

The Most Economical, Efficient and Reliable

WATER GAS APPARATUS

In the World for Small to Medium Works.

Can be put into Coal Gas Works at a price the interest on which will not be so much as their present repair account.

This Generator is now in use in nearly every State in the Union, and everyone using it will recommend it to you.

It makes a faultless gas from whatever gas-producing materials are cheapest in the locality where required, using hard coal or coke in connection with Lima crude or any other crude petroleum or its distillates, including *Naphtha of any specific gravity.*

I build these Generators with any required capacity, from 3,000 cubic feet per hour upward.

In more than one half the gas works in the country the "Little Giant" will enable *one man* to easily make, in *five hours*, all the gas needed for the *twenty-four hours*.

If gas coal is very cheap and anthracite coal and hard coke very expensive with you, put in a Little Giant Generator, as many others have done, *to use up your surplus coke, and to rush up your holder when hard pressed*.

All work and results guaranteed.

Contracts Taken for Entire Works and Special Attention Given to Holders.

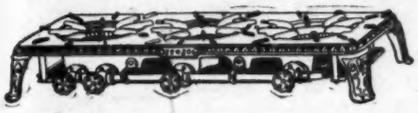
A. M. SUTHERLAND, - - - - No. 231 Broadway, N. Y. City.

JEWEL GAS STOVES

A few of the world's best Gas Stoves. All prominent demonstrators of cooking use them. Nine-tenths of the Chicago apartment houses are furnished with the same . . . . . .

One Name
Covers All.

52 Styles of Cookers.
54 Styles of Heaters.



A JEWEL CATALOG
IS WORTH THE ASKING.

GEORGE M. CLARK & COMPANY, Makers, CHICAGO.

Eastern Agency, 152-154 West 23d Street, N. Y. City.

Fire King Gas Stoves and Ranges.

BEST IN THE WORLD.

The accompanying cut shows our New Table Gas Range, which is listed at only **$12.00.** This is the Gas Stove to sell to the majority of people, who hesitate about paying out very much money for a large Gas Range.

We have gotten out more new patterns than any other manufacturer of Gas Stoves in the World. . . . . .

Send for New Catalogue, Just Out.

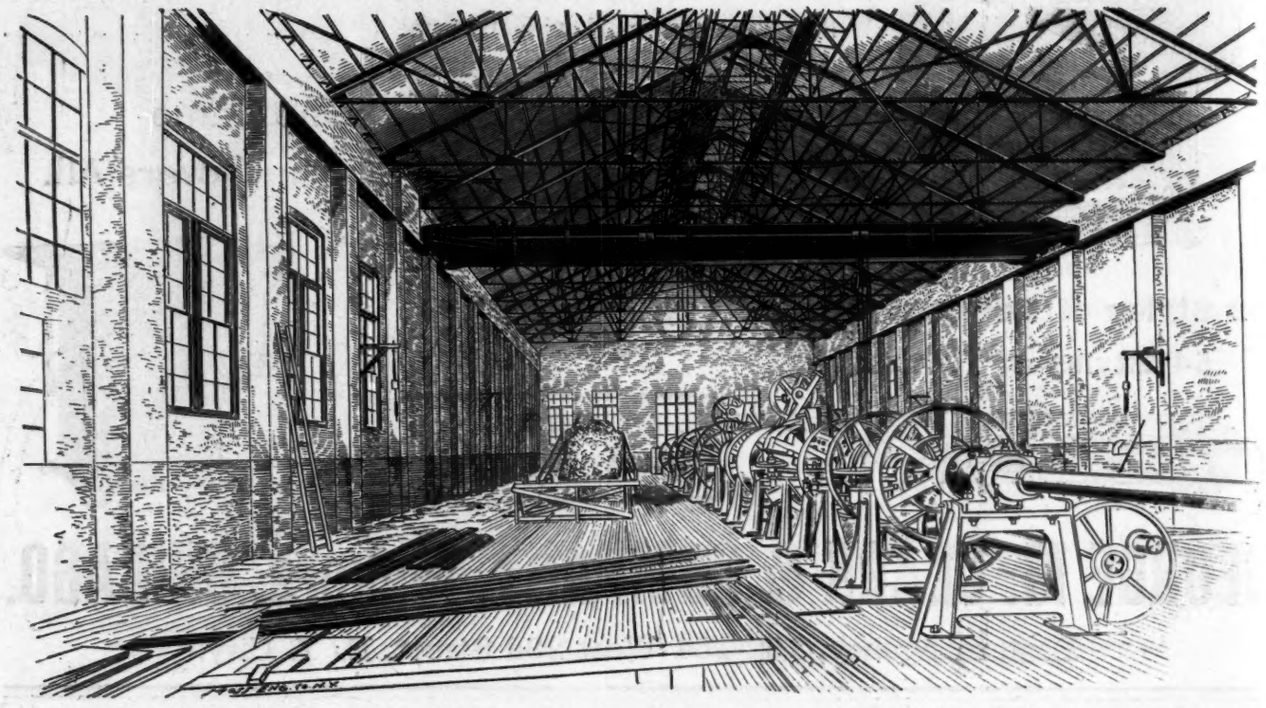
A. WEISKITTEL & SON, - - Baltimore, Md.

New England Agents, WALDO BROS., Boston, Mass.

CHAS. M. JARVIS, Prest. & Chief Engineer. BURR K. FIELD, Vice-President. GEO. H. SAGE, Secretary. FRANK L. WILCOX, Treasurer.

THE BERLIN IRON BRIDGE CO.

Engineers, Architects, and Builders of Iron and Steel Structures.



The above illustration is taken direct from a photograph, and shows the interior of the Dynamo Room in the Electric Lighting Plant of the Elmira Electric Illuminating Company, at Elmira, N. Y. Besides this, there is a Boiler and Engine Room adjacent to the Dynamo Room. We furnished the Traveling Crane as well as the Iron Roof. The roof is covered with our Patent Anti-Condensation Corrugated Iron, and is guaranteed absolutely fireproof, and not to drip from the underside during the coldest weather. The photograph was taken after the Roof Trusses and Traveling Crane were placed, but before the machinery was started.

Write for Illustrated Catalogue.

Office and Works, No. 6 Railroad Avenue, East Berlin, Conn.

ALEX. C. HUMPHREYS, M.E., MANHATTAN LIFE BUILDING, (64 BROADWAY,) NEW YORK.

CABLE ADDRESS, LONDON & NEW YORK, "HUMGLAS."

ARTHUR G. GLASGOW, M.E., 9 VICTORIA ST., LONDON, S. W., ENGLAND.

HUMPHREYS & GLASGOW,

CONTRACTING AND CONSULTING

GAS ENGINEERS.

WATER GAS PLANT A SPECIALTY.
GAS PROPERTIES EXAMINED AND VALUED.
ADVICE AS TO IMPROVEMENT OF GAS PROPERTIES AND MANAGEMENT.

THE MANAGEMENT OF SMALL GAS WORKS.

By C. J. R. HUMPHREYS.

Price $1.

A. M. CALLENDER & CO., No. 32 Pine Street New York.

(Copyrighted, 1894, by the AMERICAN METER CO.

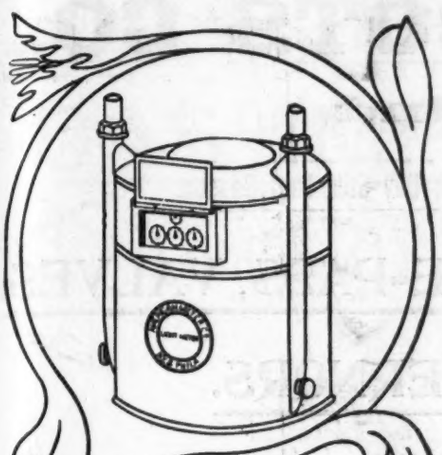
AMERICAN METER CO.

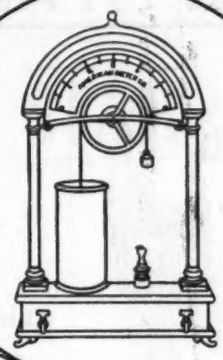
ESTABLISHED 1834. INCORPORATED 1868.

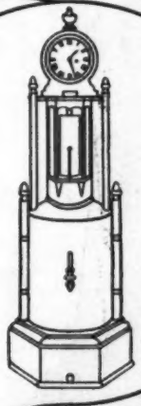
NEW YORK AND PHILADELPHIA,

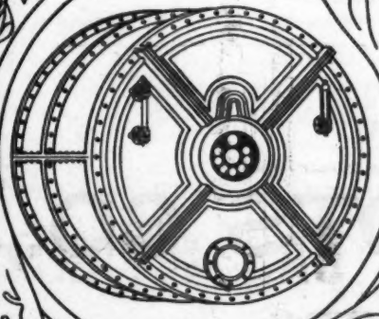
CHICAGO, ST. LOUIS,

SAN FRANCISCO.









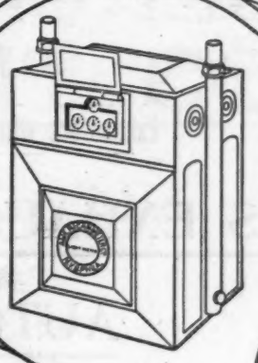
PUBLIC LIGHTING TABLE.

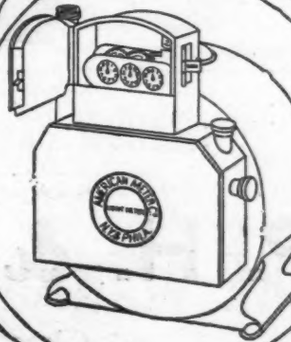
MAY, 1896.

Day of Week.	Date.	Table No. 1. FOLLOWING THE MOON. Light.	Extinguish.	Table No. 2. NEW YORK CITY. ALL NIGHT LIGHTING. Light.	Extinguish.
				P.M.	A.M.
Fri.	1	7.20 PM	1.00 AM	6.45	4.00
Sat.	2	7 20	1.40	6.45	4.00
Sun.	3	7.30	2.10	6.45	4.00
Mon.	4	7.30 LQ	2.30	6.45	4.00
Tue.	5	7.30	3.00	6.45	4.00
Wed.	6	7.30	3.20	6.45	4.00
Thu.	7	7.30	3.40	6.55	3.40
Fri.	8	7.30	3.50	6.55	3.40
Sat.	9	7.30	3.50	6.55	3.40
Sun.	10	7.40	3.50	6.55	3.40
Mon.	11	7.40	3.50	6.55	3.40
Tue.	12	7.40 NM	3.50	6.55	3.40
Wed.	13	7.40	3.50	6.55	3.40
Thu.	14	7.40	3.50	7.00	3.30
Fri.	15	7.40	3.50	7.00	3.30
Sat.	16	7.40	3.50	7.00	3.30
Sun.	17	10.50	3.40	7.00	3.30
Mon.	18	11.20	3.40	7.00	3.30
Tue.	19	11.50 FQ	3.40	7.00	3.30
Wed.	20	12.20 AM	3.40	7.00	3.30
Thu.	21	12.40	3.40	7.10	3.15
Fri.	22	1.10	3.40	7.10	3.15
Sat.	23	1.40	3.40	7.10	3.15
Sun.	24	2.10	3.40	7.10	3.15
Mon.	25	No L.	No L.	7.10	3.15
Tue.	26	No L. FM	No L.	7.10	3.15
Wed.	27	No L.	No L.	7.10	3.15
Thu.	28	7.50 PM	10.40 PM	7.15	3.15
Fri.	29	7.50	11.30	7.15	3.15
Sat.	30	7.50	12.10 AM	7.15	3.15
Sun.	31	7.50	12.40	7.15	3.15

TOTAL HOURS LIGHTING DURING 1896.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	220.40	January	423.20
February	207.00	February	367.40
March	193.00	March	355.35
April	174.10	April	298.50
May	164.00	May	264.50
June	142.10	June	234.25
July	142 10	July	243.45
August	150.50	August	280.25
September	163.00	September	321.15
October	193.10	October	374.30
November	207.00	November	401.40
December	237.30	December	433.45
Total, yr.	2194.40	Total, yr.	4000.00





P. H. & F. M. ROOTS CO.,

Connersville, Ind.

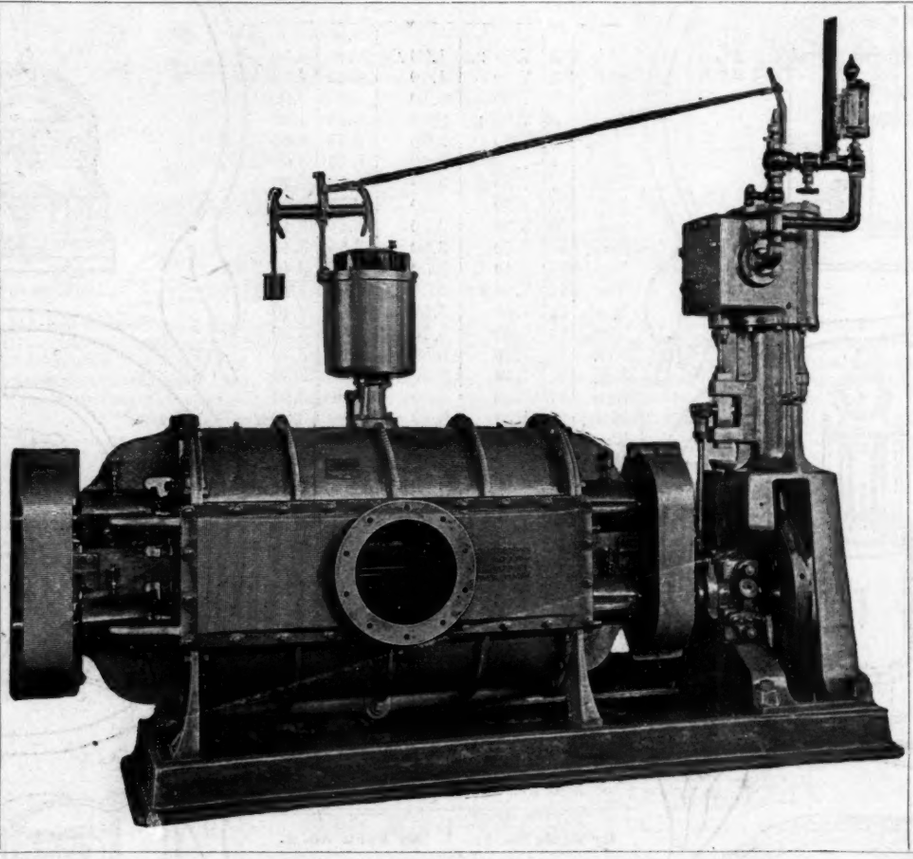
Exhausters with Combined Capacity of 75,000,000 Feet per Day Sold Last Season.

GAS EXHAUSTERS. BYE-PASS VALVES.

AUTOMATIC GAS GOVERNORS.

GAS VALVES. PIPE FITTINGS.

New Design of Direct Connected Engine and Exhauster on Same Bedplate.



This Design is Used for all Exhausters from No. 7 to No. 10, Inclusive.

Write for Illustrated Catalogue.
Estimates submitted on application.

P. H. & F. M. ROOTS CO.,

Connersville, Indiana.

New York Office, 109 Liberty Street, J. B. STEWART, Manager.

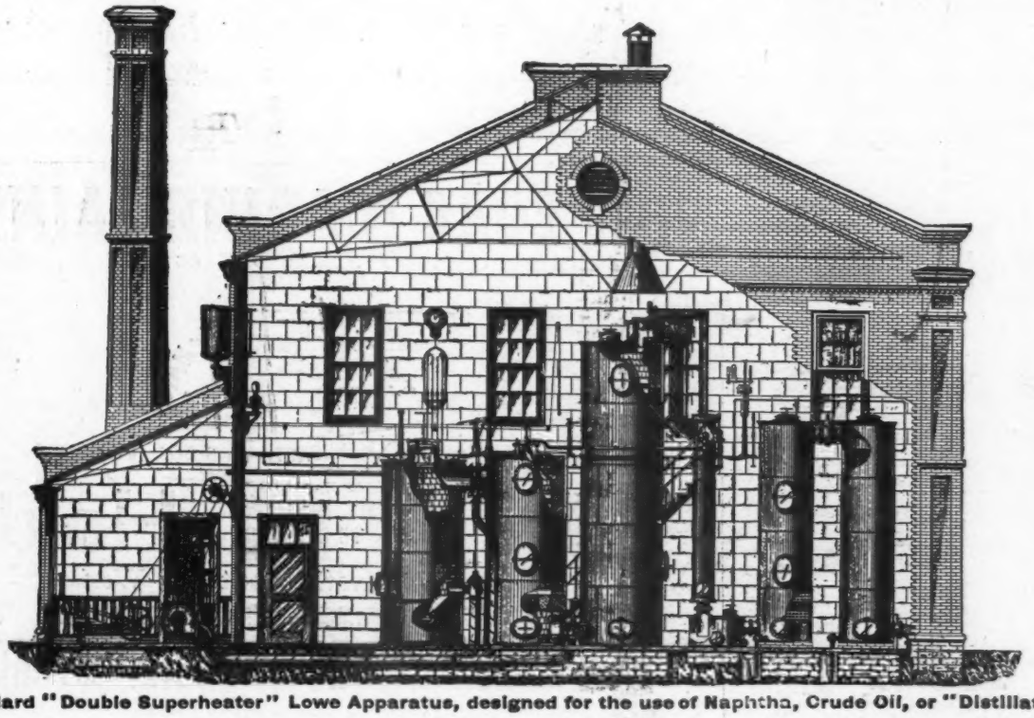
THE UNITED GAS IMPROVEMENT CO.,

DREXEL BUILDING, PHILA., PA.

Inquiries from any part of the United States should be addressed to the Philadelphia Office.

BUILDERS OF

THE STANDARD LOWE WATER GAS APPARATUS.



Standard "Double Superheater" Lowe Apparatus, designed for the use of Naphtha, Crude Oil, or "Distillates."

BUILDERS, LESSEES AND PURCHASERS OF GAS WORKS.

Water Gas Plants, either independent or auxiliary to Coal Gas Works, erected to meet any conditions. Apparatus designed to use any grade of Oil, and Anthracite Coal, or Gas House or Oven Coke.

PAMPHLETS, PLANS AND ESTIMATES FURNISHED UPON APPLICATION.

THE WESTERN GAS CONSTRUCTION CO.,

ENGINEERS and BUILDERS,

FORT WAYNE, INDIANA.

Water Gas Apparatus . . .

Improved Double Superheater Settings,
Improved Single Superheater Settings,
Special Designs for Small Works.

Our apparatus is designed to use any grades of Oils or Naphthas, Gas House or Oven Coke, or Anthracite Coal. Results are Guaranteed.

Coal Gas Apparatus . . .

Agents and Builders { For FRED. BREDEL—Washers and Purifying System, Mouthpieces and Bench Castings.
For GEO. SHEPARD PAGE'S SONS—Walker Ammonia Concentrators and Sulphate Stills, Walker Patent Mouthpieces.

Manufacturers of THE WESTERN GAS VALVE, all Iron, Double Gate, 4 to 36 Inch.

Purifiers, Condensers, Scrubbers, Street Main Specials, Iron Roofs, Iron Floors, Oxide Elevators and Conveyer Machinery.

New York Office, 32 Pine Street, WM. HENRY WHITE, Engr.

THE

LUDLOW VALVE MFG. CO.,

MANUFACTURERS OF

VALVES,

Double and Single Gate, ¼ in. to 72 in., outside and inside Screws. Indicator, etc., for Gas, Water, Steam, Oil and Ammonia.

SEND FOR CIRCULAR.

SEND FOR CIRCULAR.

ALSO,

Hydraulic Main Dip Regulators, Check Valves, Foot Valves, Yard Wash and Fire Hydrants.

OFFICE AND WORKS:
938 to 954 River St. & 67 to 83 Vail Av.
TROY N Y.

NEW YORK MARINE PAINT CO.

Successors to TRACY & HADDEN.

TRADE MARK
MANUFACTURERS OF

PAINT PECULIARLY ADAPTED TO STAND ON Holders

And all Ironwork about Gas Works.

POUGHKEEPSIE, N. Y.

CHAPMAN VALVE MANUFACTURING CO.,

MANUFACTURERS OF

Valves and Gates for Gas, Ammonia, Water, Etc.

Also, Gate Fire Hydrants with and without Independen Nozzle Valve. All Work Guaranteed.

Works & Gen'l Office, Indian Orchard, Mass, Treasurer's Office, 72 Kilby & 112 Milk Sts., Boston Mass
Chicago Office, 24 West Lake St. New York Office, 28 Platt St.
St. Louis Office, L. M. Rumsey Mfg. Co., 810 North Second St

GASHOLDER TANKS AND GAS WORKS MASONRY COMPLETE

Plans prepared and Estimates furnished at short notice.

J. P. WHITTIER,

70 Bush St., Near Division Ave., Brooklyn, N. Y.

The Gas Engineer's Laboratory Handbook.

By JOHN HORNBY, F.I.C.

Price, $2.50.

A. M. CALLENDER & CO., 32 Pine Street N. Y. City

NATIONAL GAS AND WATER CO.,

218 La Salle Street, Chicago.

Builder and Operator of Gas Works.

The Rew Soft Coal Carbureted Water Gas Apparatus.

TESTED BY TWO YEARS' PRACTICAL OPERATION, AND FULLY GUARANTEED.

Plans and Estimates Upon Application.

IRWIN REW, President & Treasurer. N. A. McCLARY, Secretary & Gen'l Manager. E. E. MORRELL, Engineer.

CONNELLY IRON SPONGE AND GOVERNOR CO.,

(Successors to CONNELLY & CO.)

MANUFACTURERS OF GAS WORKS SPECIALTIES.

"IRON SPONGE." Saves money, saves labor, and is the most efficient purifying material ever offered as a substitute for lime. We guarantee a large saving, both in cost of material and labor.

AUTOMATIC GOVERNOR. OVER FOUR HUNDRED NOW IN USE! NO WORKS COMPLETE WITHOUT IT! WILL PAY FOR ITSELF WITHIN A YEAR! ITS SERVICE SECURES PERFECT DISTRIBUTION. REDUCES LEAKAGE TO MINIMUM, and BENEFITS THE COMPANY and CONSUMER ALIKE! IT IS THE ONLY RECOGNIZED AUTOMATIC GOVERNOR IN THE WORLD!

STEAM JET EXHAUSTER. Designed particularly for small works. Combines Exhaust Tube, Steam Governor, Gas Compensator and Bye-Pass Valves in the most compact form possible. Occupies but little space; uses very little steam; saves formation of carbon in retorts; increases yield 10 to 15 per cent. No works too small to use them profitably.

Prices given on all our specialties, delivered at any point in the United States. Correspondence solicited.

CONNELLY IRON SPONGE AND GOVERNOR CO., No. 365 Canal St., New York.

Practical Photometry.

A GUIDE TO THE STUDY OF THE MEASUREMENT OF LIGHT.

By William Joseph Dibdin.

Price, $3.00.

A. M. CALLENDER & CO.,

32 Pine Street, N. Y. City.

DOUGLAS' FERRIC OXIDE

For Gas Purification

Is a superior natural Hydrated Oxide of Iron. Will give a higher purification per bushel than any other material. We ship the pure Oxide of Iron, containing no sawdust, thus effecting a saving in freight, leaving the consumer to furnish the diluent at a nominal cost. It is now used by the largest gas companies in the West.

Full information, with references to many users, and prices delivered in any locality, furnished on application to

H.W. Douglas (Supt. Ann Arbor Gas Company) **Ann Arbor, Mich.**

IRON MASS

For Gas Purification.

Acts immediately, and more efficiently than any other purifying agent now in use.

Greenpoint Chemical Works.

JOHN SCHRIEVER, Manager.

Greenpoint Ave. & Newtown Creek, Brooklyn N.Y

BOOKS.

DISTILLATION OF COAL TAR AN AMMONIACAL LIQUOR.

By George Lunge. Price $12.50.

TREATISE ON THE COMPARATIVE COMMERCIAL VALUES OF GAS COALS AND CANNELS.

By David A. Graham. 8vo., Cloth. Price $3.

Orders for these books may be sent to this office.

A. M. CALLENDER & CO., 32 Pine St., N. Y. City

The American Gas Engineer and Superintendent's Handbook.

By WM. MOONEY.

350 Pages, Full Gilt Morocco. Price. $3.00.

A. M. CALLENDER & CO., 32 Pine St., N. Y.

JAMES D. PERKINS. **PERKINS & CO.,** F. SEAVERNS.

228 and 229 Produce Exchange, New York City.

TIDEWATER SALES AGENTS FOR THE FOLLOWING

Standard Gas Coals and Cannel.

Ocean Mine Youghiogheny Gas Coal,

From Baltimore.

Clinch Valley, Thacker & Logan Gas Coals

From Norfolk, Va.

Old Kentucky Shale and O. K. Boghead,

From Kentucky,

The Most Valuable Enricher Now Obtainable.

Second Only to the Celebrated Australian Shale.

Cargo Shipments from New York, Philadelphia, Baltimore and Norfolk.

Single carloads or more delivered at any required point in the United States or Canada.

BERWIND-WHITE COAL MINING COMPANY'S

Ocean Westmoreland Gas Coal.

Offices:

55 Broadway, New York.

Betz Building, Philadelphia.

STRICTLY High Grade. . . . .
Carefully prepared.
For Gas Making or
Heavy Steaming.

Coal Tar Genealogical Tree

MR. T. VINER CLARKE, of London, Eng., having compiled a novel Chart or Map illustrating the various

CHEMICAL PRODUCTS DERIVED FROM COAL AND COAL TAR,

In the form of a Genealogical Tree, including all the products discovered to date (the total number amounting to near 700), offers for sale a limited number of copies in Colors, mounted on Linen, with Rollers. Price, $3.50. Orders may be sent to

A. M. CALLENDER & CO., - - No. 32 Pine Street, New York.

GAS ENRICHERS. GAS COALS. GAS COALS.

The Despard Gas Coal Co.,

MINERS AND SHIPPERS OF

DESPARD GAS COAL,

AND MANUFACTURERS OF

COKE.

MINES, - - Clarksburgh, Harrison Co., West Va.
WHARVES, - - - Locust Point, Baltimore, Md.
OFFICE, - - - 44 South Street, Baltimore, Md.

ROUSSEL & HICKS, 71 Broadway, N. Y. } AGENTS, { BANGS & HORTON 60 Congress St., Boston.

HENRY G. SCHEEL,

Tidewater Sales Agent and Shipper of High Grade Westmoreland Vein, Youghiogheny, and West Virginia

Thoroughly Screened

GAS COALS.

Superior Kentucky Gas Cannel, Connellsville and Mountain Coke, Clearfield and Cumberland Vein Steam and Smithing Coals.

Room 176, Washington Building, No. 1 Broadway, N. Y. City.

WILBUR H. TOWNSEND,

BROKER AND DEALER IN

Naphthas, Gas and Fuel Oils and Crude Petroleum for Gas Companies.

Room 164, 29 Broadway, N.Y. City.

KELLER ADJUSTABLE COKE CRUSHER.

Strong, Simple, Durable. Will Crush any Size Desired.

C. M. KELLER,
Sec. & Supt. Gas Lt. & Coke Co.,
Columbus, Ind.
Correspondence Solicited.

GREENOUGH'S "DIGEST OF GAS CASES."

Price, $5.00.

This is a valuable and important work, a copy of which should be in the possession of every gas company in the country, whether large or small. As a book of reference it will be found invaluable. It is the only work of the kind which has ever been published in this country, and is most complete. Handsomely bound. Orders may be sent to

A. M. CALLENDER & CO., 39 Pine St., N. Y.

GAS COALS.

— THE —

PENN GAS COAL CO.

OFFER THEIR

Coal, Carefully Screened and Prepared for Gas Purposes.

Their property is located in the Youghiogheny Coal Basin, near Irwin and Penn Stations on the Pennsylvania Railroad, and on the Youghiogheny River.

Principal Office:

Room 720, Reading Terminal Building, Phila., Pa.

Points of Shipment:

Pennsylvania Railroad Piers; Greenwich Wharves, Delaware River; Pier No. 1 (Lower Side), South Amboy, N. J.

EDMUND H. MCCULLOUGH, Prest. CHAS. F. GODSHALL, Treas. H. C. ADAMS, Sec.

THE WESTMORELAND COAL CO.

Chartered 1854.

Mines situated on the Pennsylvania and the Baltimore and Ohio Railroads, in Westmoreland County, Pa.

POINTS OF SHIPMENT:

PHILADELPHIA, BALTIMORE, SOUTH AMBOY, N. J., WATKINS (SENECA LAKE), N. Y.

Since the commencement of operations by this Company its well-known Coal has been largely used by the Gas Companies of New England and the Middle States, and its character is established as having no superior in gas-giving qualities, and in freedom from sulphur and other impurities.

Principal Office, 224 South 3d St., Phila., Pa.

THE SUN OIL CO.,

OHIO CRUDE OIL,

38 to 41 Degrees Gravity.

Toledo, O., and Pittsburgh, Pa.

Standard Oil Company,

GAS NAPTHA DEPARTMENT.

GAS NAPTHA.

GAS OIL.

Correspondence Solicited.

26 Broadway, New York City

RETORTS AND FIRE BRICK. RETORTS AND FIRE BRICK. RETORTS AND FIRE BRICK.

CHAS. E. GREGORY, Prest. DAVID R. DALY, V.-Prest. & Treas. H. D. ABERNETHY, Sec.

J. H. GAUTIER & COMPANY

CORNER OF

GREENE AND ESSEX STREETS,

JERSEY CITY, N. J.

MANUFACTURERS OF

Clay Gas Retorts,

Gas House Tiles,

Fire Bricks, Etc. Etc.

Ground Clay, Fire Brick and Fire Sand in Barrels.

Brooklyn Fire Brick Works,

MANUFACTURERS OF

CLAY RETORTS, FIRE BRICK,

Gas House and other Tile.

Office, 88 Van Dyke St., Brooklyn, N. Y.

LACLEDE FIRE BRICK MFG. CO.,

MANUFACTURERS OF

Fire Brick, Gas Retorts,

AND

ST. LOUIS STANDARD SEWER PIPE.

Blast Furnace and Cupola Linings, every description of Fire Clay Material, Fire Clay Flue Linings, Chimney Tops Dry Milled and Crude Fire Clays, etc.

OFFICE AND DEPOT

901, 903, and 905 Pine Street

ST. LOUIS, MO.

ESTABLISHED IN 1845.

B. KREISCHER & SONS,

OFFICE FOOT OF HOUSTON ST., E.R., N.Y.

Gas Retorts,

TILES, FIRE BRICK.

AND EVERYTHING IN THE FIRE CLAY LINE.

ADAM WEBER,

Proprietor,

Manhattan Fire Brick and Enameled Clay Retort Works

Works, Weber, N. J.

Office, 633 East 15th St., New York.

Modern Recuperative Furnaces

AND

Standard Fire Brick and Gas Retorts.

Works, LOCKPORT STATION, PA.

—ESTABLISHED 1864.—

JAMES GARDNER, JR.,

Conestoga Bldg., Wood & Water Sts. PITTSBURGH, PA. P. O. Box 373.

Successor to WILLIAM GARDNER & SON.

Fire Clay Goods for Gas Works.

SOLE REPRESENTATIVE OF THE McILHENNY REGENERATIVE BENCHES FOR THE U. S.

HENRY MAURER & SON,

(ESTABLISHED 1856.)

EXCELSIOR FIRE BRICK & CLAY

RETORT WORKS

WORKS, Perth Amboy, N. J.

OFFICE, 418 to 422 East 23d St., N. Y

Clay Gas Retorts,

BENCH SETTINGS,

Fire Brick, Tiles, Etc.

GEROULD'S IMPROVED RETORT CEMENT.

A cement of great value for patching retorts, putting on mouthpieces, making up all bench-work joints, lining blast furnaces and cupolas. This cement is mixed ready for use. Economic and thorough in its work. Fully warranted to stick.

PRICE LIST.

In Casks, 400 to 800 pounds, at 5 cents per pound.
In Kegs, 100 to 200 " " 6 " "
In Kegs less than 100 " " 7 " "

C. L. GEROULD & CO.,

N. 3d & Prospect Avs., Mt. Vernon, N.Y.

Western Agent, H. T. GEROULD, Centralia, Ills.

Parker-Russell Mining and Mfg. Co.,

CITY OFFICE,

417 Pine Street, St. Louis, Mo.

PROPRIETORS OF THE

OAKHILL GAS RETORT & FIRE BRICK W'KS

Our immense establishment is now employed almost entirely in the manufacture of

Materials for Gas Companies

We have studied and perfected three important points. Our retorts are made to stand changes of temperature, the strongest heats of the furnace, and the abrasion of feeding and emptying. We construct

Half and Full Depth Benches of Our Own Design,

Containing 6, 8 or 9 Retorts.

We have Greatly Improved our Recuperators. Coal or Coke can be used as Fuel in Furnaces.

THEO. J. SMITH, Prest. J. A. TAYLOR, Sec'y.
A. LAMBLA, Vice-Prest. and Supt.

BALTIMORE RETORT & FIRE BRICK CO.

MANUFACTORY AT

LOCUST POINT BALTIMORE MD.

Clay Retorts, Blocks & Tiles

FIRE BRICK, FIRE CLAY,

AND FIRE CEMENT.

Red and Buff Ornamental Tiles and Chimney Tops. Baker Oven Tiles 12x12x2 and 10x10x2.

WALDO BROS., 88 WATER ST., BOSTON, MASS

Sole Agents for New England States.

PRACTICAL PHOTOMETRY.

A Guide to the Study of the Measurement of Light.

By WILLIAM JOSEPH DIBDIN.

With Numerous Illustrations. Price, $3.00. A. M. CALLENDER & CO., 32 Pine Street, N. Y. City.

FRED. BREDEL, C.E.

Coal and Water Gas Plants,

OWN SYSTEM.

Recuperative Furnaces, Washers, Condensers, Purifiers, Purifying Machines.

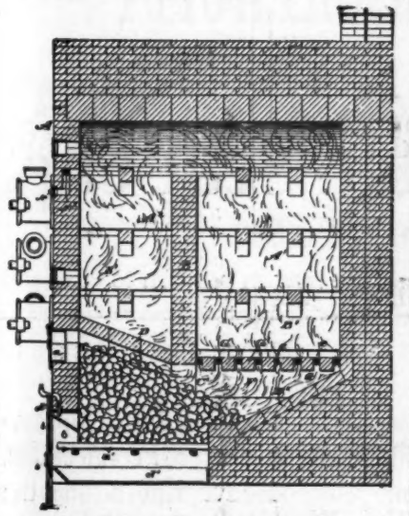
Gas Enriching Plants to Enrich Coal Gas up to 24 Candle Power, and Making a White, Bright, Non-smoking Gas.

COMPLETE GAS WORKS, COKE CONVEYERS, ETC.

No. 118 Farwell Avenue, · · Milwaukee, Wis.

FLEMMING'S

Generator-Gas Furnace



Materials furnished and Benches erected by

J. H. GAUTIER & CO., - Jersey City, N. J.

Address as above, or D. D. FLEMMING, Jersey City, N. J.

AMERICAN GAS LIGHT JOURNAL.

$3.00 per Annum.

A. M. CALLENDER & CO.

39 Pine Street, N. Y

A CONVENIENT

BINDER for the JOURNAL

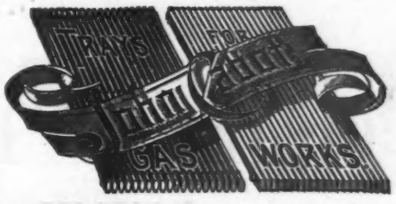
STRONG.
DURABLE.
LIGHT.
SIMPLE
CHEAP.
HANDSOME.
Price, $1.

A.M. Callende & Co.,
39 Pine st.,
N. Y. City

Special Trays for Iron Sponge or Oxide of Iron.

CHURCH'S TRAYS a Specialty.

Reversible, Strongest, Most Durable, Most Easily Repaired.



306-310 Eleventh Avenue, New York.

We also make the Cheapest and Strongest REVERSIBLE BOLTED TRAYS IN THE MARKET.

Send for Circulars.

Parson's Steam Blower,

FOR IMPROVING BAD DRAUGHT IN BOILERS, AND FOR BURNING BREEZE OR OTHER WASTE MATERIAL.

PARSON'S TAR BURNER.

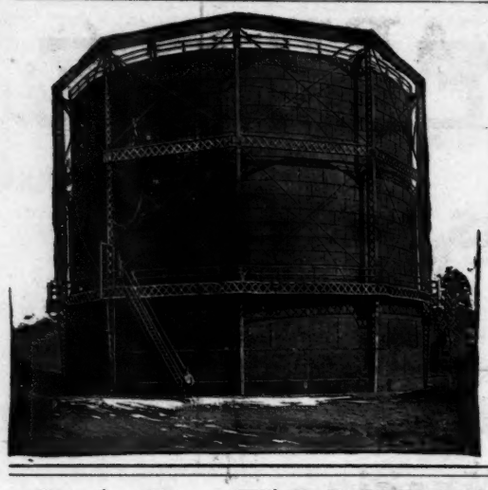
FOR UTILIZING COAL TAR AS FUEL.

PARSON'S AIR JET TUBE CLEANER,

FOR CLEANING BOILER TUBES.

These devices are all first-class. They will be sent to any responsible party *for trial.* No sale unless satisfactory. Manufactured by the WATERTOWN STEAM BLOWER COMPANY

H. E. PARSON. Supt., 621 Broadway, N. Y.



DAVIS & FARNUM MFG. CO.,

WALTHAM, MASS.

Principal Office & Works, Waltham, Mass. Boston Office, R'm 18, Vulcan Bldg., 8 Oliver St.

Single, Double and Triple-Lift Gasholders of any Capacity. Tubular, Pipe and Sinuous Friction Condensers of all Sizes.

Steel Tanks for Gasholders, Iron Roof Frames and Floors, Purifying Boxes, Center Seal or Valve Connections, Bench Work, Reversible Lime Trays.

Self-Sealing and Pressed Steel Mouthpiece Lids.

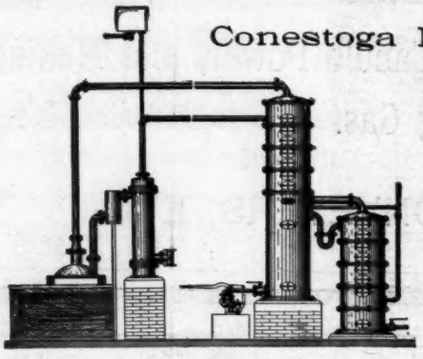
Coke Borrows, Coal Wagons, and all Apparatus Requisite for a Complete Gas Works.

Also, Gas and Water Pipe, Flanged Pipe, Sugar House Work, and Special Castings of all Descriptions.

GAS ENGINEERING COMPANY,

INCORPORATED,

Conestoga Building, PITTSBURGH, PA.



AMMONIA MACHINE.

MANUFACTURERS OF

Gas Works Machinery of all kinds,

PATENTEE AND OWNER OF

PITTSBURGH WASHER-SCRUBBER,

SOLE AGENT FOR

FELDMANN AMMONIA MACHINE,

For producing Sulphate, Aqua, Chloride and Concentrated Liquors.

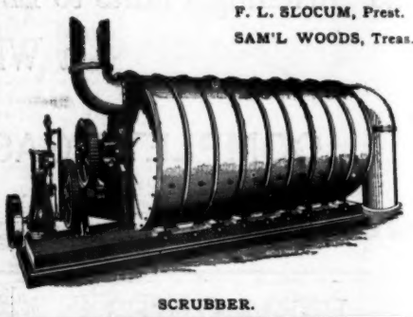
The Erection of Bi-Product Coke Ovens a Specialty.

Faux System of Recuperative Benches,

JAS. GARDNER, JR.
SOLE CONSTRUCTOR AND BUILDER.

NEW SYSTEM HYDRAULIC MAIN.

F. L. SLOCUM, Prest.
SAM'L WOODS, Treas.



SCRUBBER.

INCREASE YOUR PURIFYING CAPACITY

BY THE USE OF THE

"Crighton" Four-Box Center Seal Cap.

Having recently perfected and patented a Five-way Center Seal Cap, we are now in position to offer and recommend it to Gas Companies for increasing their purifying capacity at a moderate cost.

With this Cap you can have **all your Purifying Boxes in constant use,** and where four boxes are in operation at one time, **the capacity is increased one-third.**

Your present Center Seal can be used, and will **only require a new Cap.** Under ordinary circumstances **the change can be made in one day,** and will not necessitate the disturbing of your connections.

Now is the time to make the change, as the work can be done to good advantage during the season of your lightest output.

For information and prices address

KERR MURRAY MFG. CO.,

Manufacturers of Gas Works Apparatus and Holders,

FORT WAYNE, IND.

BARTLETT, HAYWARD & CO.

BALTIMORE, MD.

Triple, Double & Single-Lift

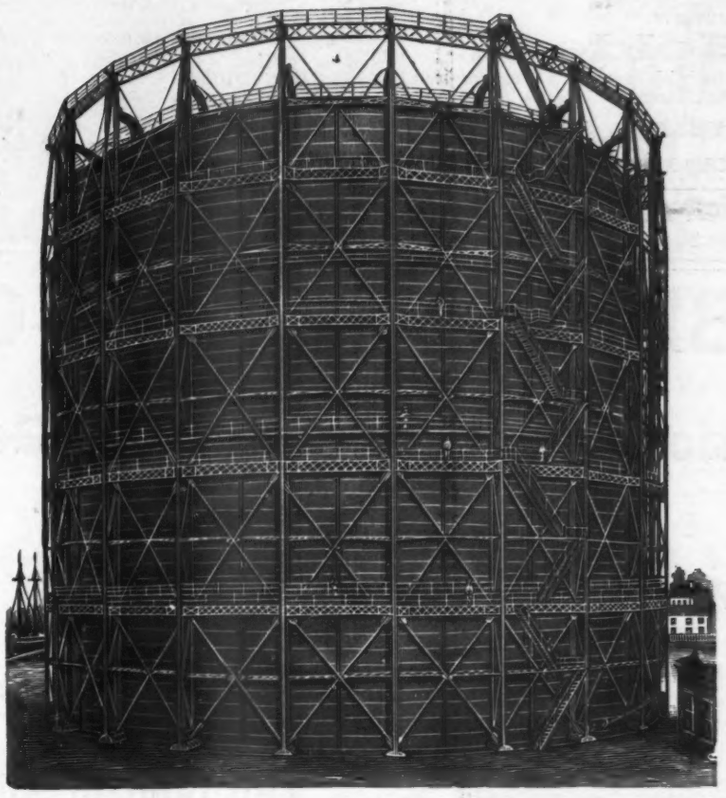
GASHOLDERS.

Iron Holder Tanks.

ROOF FRAMES.

Girders.

BEAMS



PURIFIERS.

CONDENSERS.

Scrubbers.

Bench Castings.

OIL STORAGE TANKS.

Boilers.

Three Four-Lift Gasholders, each of 4,289,500 Cubic Feet Capacity, Erected in Chicago.

The Wilkinson Water Gas Process.

THIRTY-CANDLE, NON-CONDENSABLE, FIXED GAS. THE MOST SUCCESSFUL GAS PROCESS IN OPERATION.

MILL'S REVERSIBLE LIME TRAYS.

Gas Works Designed and Constructed.

W. H. PEARSON, President. J. T. WESTCOTT, Gen'l Mang'r & Treas. L. L. MERRIFIELD, Chief Engineer.

The Economical Gas Apparatus Construction Co., Ld.

269 Front Street, East, - - Toronto, Canada.

ENGINEERS AND BUILDERS

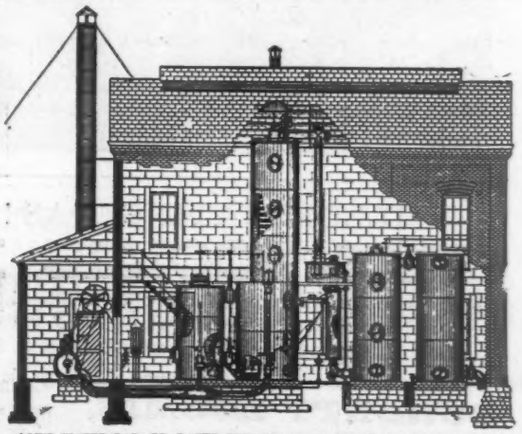
OF THE

Improved Lowe Water Gas Apparatus

Designed to give the Greatest Efficiency when using any kind of Oil, Anthracite Coal, Gas House or Oven Coke.

New Gas Works Built, Present Gas Plants, either Coal or Water, Remodeled

Catalogues, Plans and Estimates Furnished upon Application.



LOWE WATER GAS APPARATUS, MERRIFIELD-WESTCOTT-PEARSON SETTING.

R. D. WOOD & CO.,

ENGINEERS, IRON FOUNDERS, MACHINISTS.

400 Chestnut Street, Philadelphia, Pa.

MANUFACTURERS OF

CAST IRON PIPE.

BUILDERS OF

Gas Holders,

Single, Double and Triple Lifts, with or without Wrought Iron or Steel Tanks.

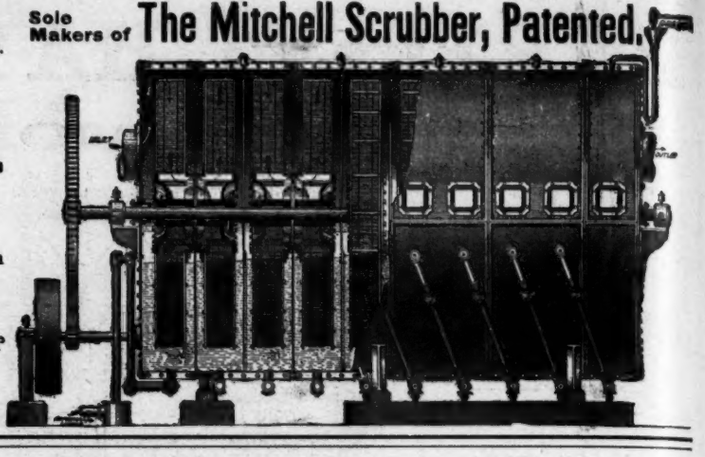
PURIFIERS, CONDENSERS, SCRUBBERS.

The Hopper Automatic Gas Governor

Send for Pamphlet.

Dunham Patent Specials.

Sole Makers of **The Mitchell Scrubber, Patented.**



ISBELL-PORTER CO.,

ENGINEERS AND CONTRACTORS FOR THE

Construction and Extension of Gas Works.

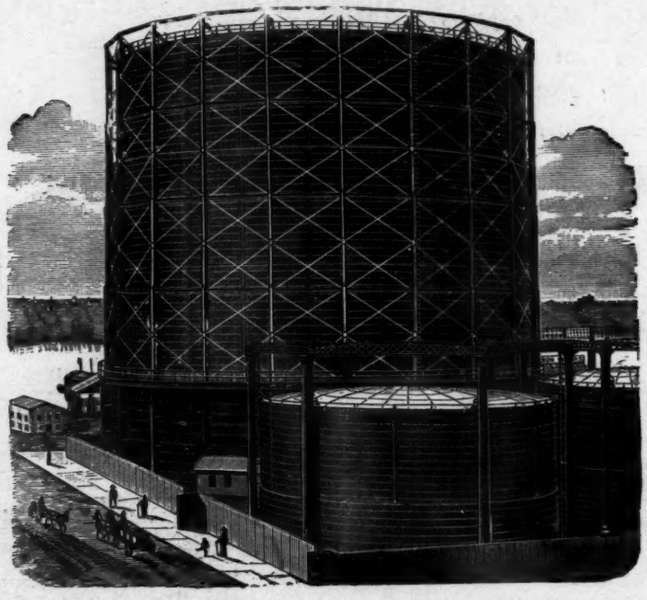
FOUNDERS AND MACHINISTS.

MANUFACTURERS OF

All Ironwork and Machinery Required in a Gas Plant.

Estimates, Drawings and Specifications furnished for the Alteration, Improvement, or Extension of Existing Works or the Construction of New Works.

245 Broadway, New York City. OFFICES **Bridge & Ogden Sts., Newark, N. J.**



The Continental Iron Works,

THOMAS F. ROWLAND, President.
WARREN E. HILL and CHAS. H. CORBETT, Vice-Presidents.
THOMAS F. ROWLAND, Jr., Secretary & Treasurer.

BROOKLYN, N. Y.

TAKE EAST TENTH OR TWENTY-THIRD STREET FERRIES FROM N. Y. TO GREENPOINT.

BUILDERS OF

Gas Holders.

Single and Multiple Section Gas Holders a Specialty.

Wrought Iron Gas Holder Tanks.

BENCH CASTINGS, RETORT LIDS.

Hydraulic Mains, Condensers, Scrubbers Purifiers, Valves, Etc.

Self-Sealing Retort Mouthpieces & Lids

For Round, Oval, or "D" Retorts.

ILLUMINATING GAS! FUEL GAS!

THE LOOMIS PROCESS.

Now in successful operation at Works of John Russell Cutlery Co., Turner's Falls, Mass., and Henry Disston's Son's Saw Works, Tacony, Pa.

The Cheapest Gas Generating System in the World.

Plans and Estimates Furnished.

BURDETT LOOMIS, - - Hartford, Conn.

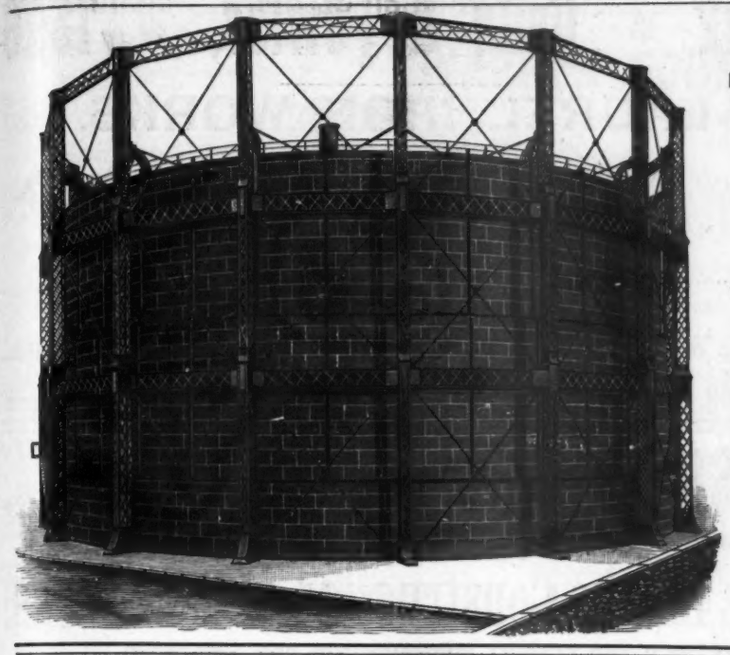
To Gas Companies.

We make to order **CAP BURNERS** to burn any amount under a stated pressure. Send for samples.

Also, SERVICE CLEANERS, DRIP PUMPS, and STREET MAIN PROVING APPARATUS.

C. A. GEFRORER,
248 N. 8th St., Phila., Pa.

GAS WORKS APPARATUS AND CONSTRUCTION. GAS WORKS APPARATUS AND CONSTRUCTION.



H. RANSHAW, Prest. & Mangr. T. H. BIRCH, Asst. Mangr
WILLIAM STACEY, Vice-Prest. R. J. TARVIN, Sec. & Treas.

THE STACEY MANUFACTURING CO
Established 1851.

Single, Double and Triple-Lift

GASHOLDERS,

Of any Capacity, with or without Wrought Iron or Steel Tanks.

Hydraulic Mains, Condensers, Scrubbers, Purifiers, Valves, etc.

Coal Gas Benches, Roof Frames,

OIL STORAGE TANKS.

Pressed Steel Mouthpiece Lids, Self-Sealing Mouthpiece Lids.

Cincinnati, Ohio.

George Shepard Page's Sons,

Sole Agents for

The "Standard" Washer-Scrubber,

The Walker Tar and Carbonic Acid Extractor, The Walker Sulphate and Ammonia Still,
The Walker Self-Sealing Pressed Steel Mouthpiece Lids.

The Berlin Center Valve. And Contractors for Ammoniacal Liquor.

No. 69 Wall Street, New York City.

GEORGE R. ROWLAND,
Formerly with the Continental Iron Works.
Draughtsman and Constructing Engineer.
Drawings, Specifications and Estimates furnished for the construction of new works or alteration of old works. Special attention given to Patent Office drawings.
Office, No. 245 Broadway, N. Y. City.

H. C. SLANEY,
Gas Engineer
466 Sixth Street, Brooklyn, N. Y.
Plans, Specifications and Estimates furnished for New Works, Alteration or Extension of Old Plants.

T. G. LANSDEN,
Consulting and Contracting Gas Engineer
Estimates, Plans and Specifications for New Works (Coal or Water Gas), and for Extensions or Alterations.
Room H, 108 N. 4th St., St. Louis, Mo.

WM. HENRY WHITE,

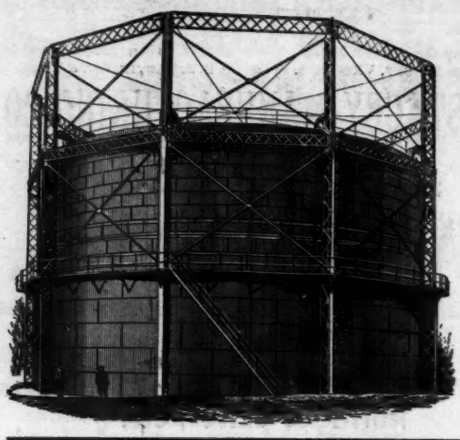
No. 32 Pine Street, - - - New York City.

ENGINEER AND CONTRACTOR FOR THE

ERECTION AND EXTENSION OF

GAS, WATER, AND ELECTRIC LIGHT WORKS.

Correspondence with Gas Companies contemplating extending or improving their Plants respectfully invited
Plans and Estimates Furnished.



1842 * Deily & Fowler, * 1896

LAUREL IRON WORKS.

Office, No. 39 Laurel Street, Philadelphia, Pa.

BUILDERS OF

Gasholders

Single or Telescopic. With or Without Iron or Steel Tanks.

OIL TANKS, WATER TANKS, AND GENERAL WROUGHT IRON WORK.

JAMES R. FLOYD & SONS,

Successors to HERRING & FLOYD,
Oregon Iron Works,

West 20th and 21st Streets, Between 10th & 11th Avenues, New York City.

Engineers and Contractors for the Construction of Gas Works.

MANUFACTURERS OF ALL KINDS OF CASTINGS AND GENERAL IRONWORK FOR GAS APPARATUS.

Bench Castings, Regenerative and Half Regenerative Furnace Castings, Condensers, Tower Scrubbers, Mechanical Scrubbers, Purifiers, Malleable Iron Retort Lids, Self-Sealing Retort Lids, Hydraulic Hoist Purifier Carriage, Crosses, Tees, Bends, Angles, Reducers, S-Bends, Sectional Sleeves, Plugs, Caps, Street Drips, etc., always on hand.

WOOD'S GAS SCRUBBING AND ENRICHING APPARATUS.

In use at Syracuse, Auburn, Watertown, Cortland and Geneva, N.Y.; Elizabeth, N. J.; Boston, Mass.; Jamaica Plain, Mass.; Providence, R. I.; Northern Liberties Gas Co., Phila.

Sole Manufacturers of the OGDEN QUICK-MOVING VALVE.

Premium Awarded, World's Columbian Exposition.

HEARNE CENTER SEAL, Operating One, Two, Three or Four Boxes.

SCIENTIFIC BOOKS.

GAS MANUFACTURE, by William Richards. 4to., with numerous Engravings and Plates, in Cloth binding. $12.

TECHNICAL GAS ANALYSIS. $3.

GAS CONSUMER'S HANDYBOOK, by Wm. Richards, C.E. 20 cents.

PRACTICAL TREATISE ON HEAT AND VENTILATION, with Special Relation to Illuminating, Heating and Cooking by Gas. By E. E. Perkins. $1.25.

CHEMISTRY OF ILLUMINATING GAS. By Norton H. Humphrys. $2.40.

PRACTICAL TREATISE ON HEAT By Thomas Box. 2d edition. $5.

PRACTICAL PHOTOMETRY: A Guide to the Study of the Measurement of Light. By W. J. Dibdin. $3.

CHEMICAL TECHNOLOGY: Vol. I., *Fuel and Its Applications*, $5. Vol. II., *Lighting*, $4.

IRONWORK: Practical Designing of Structural Ironwork. By H. Adams. $3.50.

GAS WORKS: Their Arrangement, Construction, Plant and Machinery. $5.

PRACTICAL HANDBOOK ON GAS ENGINES, by G. Lieckfield. $1.

LIQUID FUEL FOR MECHANICAL AND INDUSTRIAL PURPOSES. By E. A. Brayley Hodgetts. $2.50.

COAL, SPONTANEOUS COMBUSTION OF. By Thomas Rowan, C.E. $2.

COAL: Its History and Use. By Prof. Thorpe. $3.50.

THE GAS WORKS OF LONDON. By Colburn. 60 cents.

HEAT A MODE OF MOTION. By John Tyndall. $2.50.

THE MANAGEMENT OF SMALL GAS WORKS. By C. J. R. Humphreys. $1.

MANUAL FOR GAS ENGINEERING STUDENTS. By D. Lee. 40 cents.

THEORY OF HEAT. By J. Clerk-Maxwell. $1.50.

AMMONIA AND AMMONIUM COMPOUNDS. By Dr. R. Arnold. $2.

DIGEST OF GAS LAW. $5.

DISTILLATION OF COAL TAR AND AMMONIACAL LIQUOR. By Geo. Lunge. New edition. $12.50.

A TREATISE ON THE COMPARATIVE COMMERCIAL VALUES OF GAS COALS AND CANNELS. By D. A. Graham. $3.

THE AMERICAN GAS ENGINEER AND SUPERINTENDENT'S HANDBOOK. By William Mooney. $3.

A TEXT BOOK OF INORGANIC CHEMISTRY. By Prof. Victor Von Richter. $2.

ILLUMINATING AND HEATING GAS. By W. Burns. $1.50

HANDBOOK FOR MECHANICAL ENGINEERS. By H. Adams. $2.50.

TREATISE ON MASONRY CONSTRUCTION. Baker. $5.

GAS ENGINEER'S LABORATORY HANDBOOK. By Jno. Hornby, F.I.C. $2.50.

GAS LIGHTING AND GAS FITTING. By W. P. Gerhard. 50 cents.

PRACTICAL PLUMBING. By P. J. Davies. $3.

AMERICAN PLUMBING. By Alfred Revill. $2.

CEMENT: A Manual of Lime and Cement, their Treatment and Use in Construction. By A. H. Heath. $2.50.

ELECTRICITY.

INDUSTRIAL PHOTOMETRY, with Special Application to Electric Lighting. By A. Palaz, Sc.D. $4.

ELEMENTS OF ELECTRIC LIGHTING, Including Electric Generation, Measurement, Storage and Distribution. By Philip Atkinson. $1.50.

ELECTRIC TRANSMISSION OF ENERGY. By G. Knapp. $3.

ELECTRICIAN'S POCKETBOOK. By Monroe and Jamieson. $2.50.

MAGNETISM AND ELECTRICITY. By J. Overend. 40 cts.

DYNAMO BUILDING. By F. W. Walker. 50 cents.

DOMESTIC ELECTRICITY FOR AMATEURS. By E. Hospitalier. $2.50.

PRACTICAL MANAGEMENT OF DYNAMOS AND MOTORS. $1.

PRACTICAL GUIDE TO THE TESTING OF INSULATED WIRES AND CABLES. $1.

ELECTRIC LIGHT FITTING. $2.

PRACTICAL ELECTRICITY. $2.50.

ELECTRICITY FOR ENGINEERS. $2.50.

ELECTRIICITY, Its Theory, Sources and Applications. By John T. Sprague, M.I.E.E. $3.

The above will be forwarded by express, upon receipt of price. If sent by mail, postage must be added to above prices. We take especial pains in securing and forwarding any other Works that may be desired, upon receipt of order. All remittances should be made by check, draft, or post office money order.

A. M. CALLENDER & CO., 32 Pine Street, New York.

GAS AND WATER PIPES.

THE OHIO PIPE COMPANY,
MANUFACTURERS OF
Cast Iron Gas & Water Pipe,
BRANCH AND SPECIAL CASTINGS.
Gas-House Bench Castings, Hydraulics, Lamp Posts, Flange Pipe and Specials, Architectural Castings, Building Columns, Joists, Cellar Grates, Sash Weights, etc.
GENERAL FOUNDERS AND MACHINISTS
Columbus, Ohio.

Cast Iron Pipe
For Natural or
Artificial Gas,
Flange Pipe,
Electric Light Posts.

The Addyston
Pipe & Steel Co.,
Cincinnati, O.

The Chemistry of
Illuminating Gas.
By NORTON H. HUMPHRYS. Price, $2.40.
A. M. CALLENDER & CO., 32 PINE ST., N. Y. CITY.

GAS METERS.

WARREN FOUNDRY AND MACHINE CO.,
Established 1856. Works at Phillipsburgh, N. J.
New York Office, 160 Broadway.

CAST IRON WATER AND GAS PIPE,
FROM THREE TO FORTY-EIGHT INCHES DIAMETER. ALSO, ALL SIZES OF
Flange Pipe for Sugar House and Mine Work. Branches, Bends, Retorts, etc., etc

GEORGE ORMROD, Manger. & Treas., Emaus, Pa.
JOHN DONALDSON, Prest., Betz Bldg., Phila., Pa
EMAUS PIPE FOUNDRY.
DONALDSON IRON COMPANY. EMAUS, PA

MANUFACTURERS OF
CAST IRON PIPE AND SPECIAL CASTINGS
FOR WATER AND GAS.
Also, FLANGE PIPE, LAMP POSTS, Etc.

JOS. R. THOMAS,
No. 32 Pine Street, N.Y. City.
CONSULTING AND CONSTRUCTING
Gas Engineer and Contractor.
PLANS, SPECIFICATIONS AND ESTIMATES FURNISHED.
Contracts taken for all Appliances required at a Gas Works,
Either for New Works or Extensions to Old Plants

Management of
Small Gas Works.
By C. J. R. HUMPHREYS. Price, $1.
A. M. CALLENDER & CO., 32 PINE ST., N. Y. CITY

The Gas Engineer's
Laboratory Handbook.
BY JOHN HORNBY, F.I.C. Price, $2.50.
A. M. CALLENDER & CO., 32 PINE ST., N. Y. CITY

1894 DIRECTORY 1894
OF AMERICAN GAS COMPANIES
Price, - - - - - - - - - $5.00.
A. M. CALLENDER & CO., - - No. 32 Pine Street, New York.

METRIC METAL COMPANY,
MANUFACTURERS OF
DRY GAS METERS
For all Kinds of Service.
ALSO MAKERS OF THE
MATCHLESS CLASSIC GAS COOK STOVES AND RANGES.
Send for '96 Stove Catalogue. Factory at Erie, Pa.

Established 1849. With the best facilities for manufacturing, is enabled to furnish reliable work and answer orders promptly.

NATHANIEL TUFTS,

153 Franklin St., Boston, Mass.

C. W. HINMAN, - - Manager.

MANUFACTURER OF

DRY GAS METERS.

Station Meters of any Capacity.

Test and Experimental Meters, Pressure Registers, Pressure Gauges,

METER PROVERS, PHOTOMETERS, STREET LANTERNS, ETC., ETC.

Apparatus for the Chemical Testing of Gas and Gas Liquor.

CHARLES E. DICKEY. JAMES B. SMALLWOOD. CHARLES H. DICKEY.

THE MARYLAND METER AND MANUFACTURING CO.

Established 1866.

BALTIMORE, North & Saratoga Sts. **CHICAGO, 122 & 124 Michigan St.**
NEW YORK, 838 Broadway. **SAN FRANCISCO, 221 Front St.**
BOSTON, 92 Water Street, Rooms 21 and 22.

CONSUMERS' & STATION METERS, PRESSURE GAUGES, Etc., Etc.

"Success" and "Perfect" Gas Stoves.

THE GOODWIN METER COMPANY,

1012-1018 Filbert Street, Philadelphia, Pa.

MANUFACTURERS OF

Consumers' and Station Meters,

Standard Photometrical and Analytical Gas Apparatus

"SUN DIAL" GAS COOKING AND HEATING STOVES.

Particular attention given to Repairing Meters and Scientific Apparatus. . . .

GEORGE B. EDWARDS, Agent,
113 Chambers Street, N. Y. City.

THE KEYSTONE METER CO.,

Factory and Office, ROYERSFORD, PA.

WESTERN MANAGERS:
CAHILL, SWIFT & CO.,
121-207 South Seventh Street,
ST. LOUIS, MO.

PACIFIC:
WIESTER & CO.,
15 & 17 New Montgomery St.,
SAN FRANCISCO, CAL.

Gas Meters and Gas Stoves.

BARTLETT LAMP MFG. CO., 66 W. Broadway, N. Y. City, Agts. for New York, New Jersey & Connecticut.

GAS METERS. GAS METERS. GAS METERS.

THE AMERICAN METER CO.

Established 1834. Incorporated 1863.

WET AND DRY GAS METERS. PRESSURE REGISTERS. METER PROVERS.
STATION METERS. PRESSURE & VACUUM REGISTERS. PORTABLE TEST METERS.
EXHAUSTER GOVERNORS. PRESSURE & VACUUM GAUGES. EXPERIMENTAL METERS.
DRY CENTER VALVES. CRESSON GAS REGULATORS. AMMONIA TEST METERS.
GOVERNORS FOR GAS WORKS. MARSLAND WATER METERS. BAR & JET PHOTOMETERS.

Manufactories:
512 West 22d St., N. Y.
Arch & 22d Sts., Phila.

GAS STOVES.
SUGG'S "STANDARD" ARGAND BURNERS,
SUGG'S ILLUMINATING POWER METER,
Wet Meters, with Lizar's "Invariable Measuring" Drum.

Agencies:
125 & 127 S. Clinton Street, Chicago.
810 North Second Street, St. Louis.
222 Sutter Street, San Francisco.

HELME & McILHENNY,

(Established 1848.)

Gas Meter Manufacturers

1339 to 1349 Cherry Street, Philadelphia, Pa.

Wet and Dry Gas Meters, Station Meters, Experimental Meters, Meter Provers, Center Seals, Pressure Registers, Governors, Indicators, Photometers

AND ALL OTHER KINDS OF APPARATUS FOR USE IN GAS WORKS.

FOULIS' PATENT STATION AND DISTRICT GOVERNORS.

REPAIRING DEPARTMENT.—We employ a special force of skilled workmen repairing meters of ALL MAKERS.

D. McDONALD & CO.,

Established 1854.

154 West 27th Street, NEW YORK CITY.
51, 53 & 55 Lancaster St., ALBANY, N. Y.
34 & 36 W. Monroe St., CHICAGO, ILL.

MANUFACTURERS OF

Wet and Dry Gas Meters

STATION METERS, EXPERIMENTAL METERS, METER PROVERS, PRESSURE & VACUUM REGISTERS & PRESSURE GAUGES.

Meters of all makers Thoroughly Repaired.

(Established 1881.)

THE HILLEN METER CO.,

Manufacturers of Gas Meters.

All Sizes of Meters Constantly in Stock. Liberal Discount on Application.

Special Attention Paid to Repairing Meters of All Makers.

Address all Communications to

JOHN J. HILLEN, - - 200 Baltic Street, Brooklyn, N. Y.

NOT CONNECTED WITH ANY OTHER ESTABLISHMENT.

The Advertisement of the

OTTO GAS ENGINE WORKS,

33d and Walnut Streets, Philadelphia,

New York, 18 Vesey St. Boston, 19 Pearl St., Chicago, 245 Lake St.,

Occupies this space every alternate week.

JOHN J. GRIFFIN & CO.,

1513-1515-1517-1519-1521 Race Street, Philadelphia.

52 Dey Street, New York. WM. S. GRIBBEL, Manager.

75 N. Clinton St., Chicago. FREDERICK WAUGH, Manager.

MANUFACTURERS OF

STATION METERS, CONSUMERS' METERS,

Provers, Registers, Gauges, Experimental Apparatus, Etc.

Prompt Attention Given to All Repairing.

OUR SPECIAL NATURAL GAS METER

Is the Best ever offered. Over 30,000 now in use.

We manufacture in the United States, under the **SAWER & PURVES PATENTS,** the

Positive Prepayment Meter.

. . SIMPLE . .

. DURABLE .

. ACCURATE .

. RELIABLE .

All Parts Interchangeable

This Meter is an unqualified success in Great Britain.

Its simplicity of construction, and the positive character of the service performed by it, have given it pre-eminence.

Needs only the care given an ordinary Meter. Saves MONEY, TIME and 'CONSUMERS, 'Dispenses with "DEPOSITS" and increases OUTPUT.